20-31 August 1976 First and Third Friday Volume 142 Number 3543 30p

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Model Engineer

MAP HOBBY MAGAZINE

INTERNATIONAL MODEL LOCOMOTIVE EFFICIENCY COMPETITION—*FULL REPORT*

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Volume 142 Number 3543

20 August 1976

CONTENTS

Smoke Rings: notes by the Editor	787
International Model Locomotive Efficiency Competition	788
A rhombic drive Stirling engine	796
5 in. gauge "Rail-motor"	800
A Stephenson long-boiler locomotive	803
M.E. hot air engine competition	804
Model Marshall portable engine	805
Club Diary	810
Super Claud: 5 in. gauge 4-4-0 locomotive	811
Building a Williamson engine	816
News from the Clubs	820
Postbag: letters to the Editor	821

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COVER PICTURE

A steam wagon photographed by M. F. Wood.

NEXT ISSUE

Calculating the "backset" in Walschaerts valve gear.

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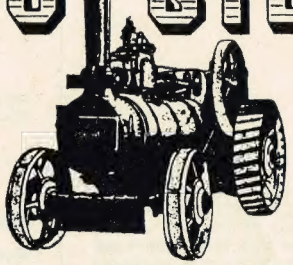

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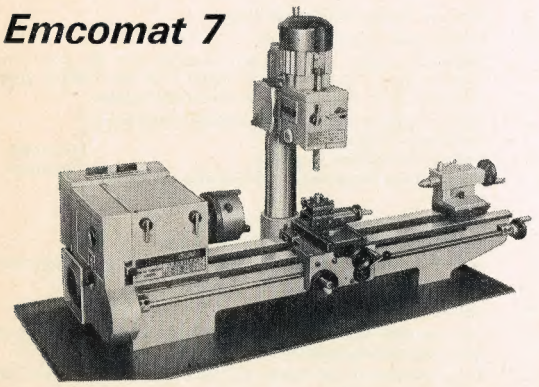

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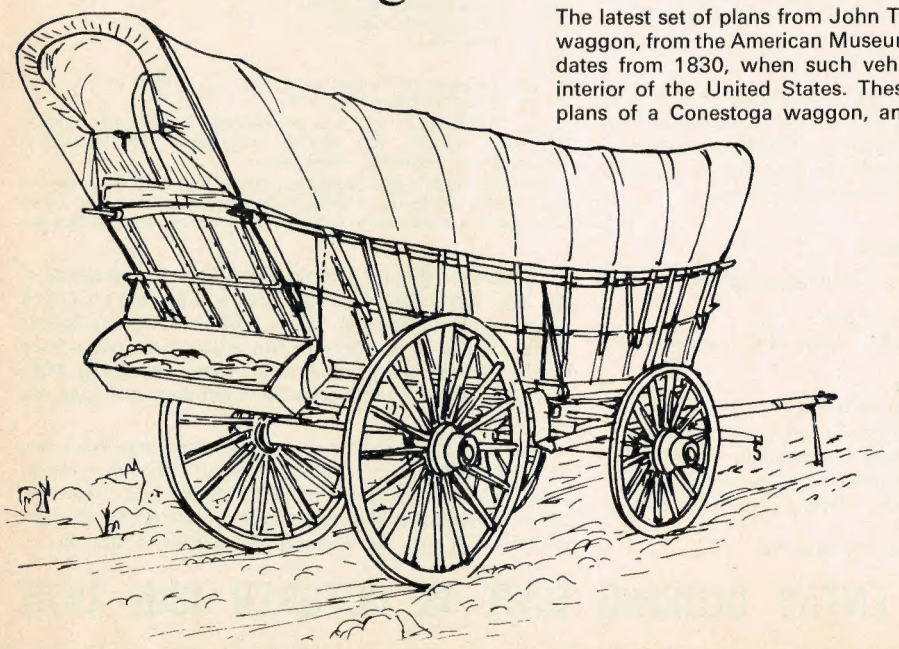

The latest set of plans from John Thompson is of the Conestoga waggon, from the American Museum near Bath. This fine example dates from 1830, when such vehicles were the lifeline to the interior of the United States. These are the first detailed scale plans of a Conestoga waggon, and are published to mark the bicentennial.

The set of 3 sheets (each 23 by 33 ins.) of fully detailed plans in $\frac{1}{8}$ in. scale includes copious notes on the history and structure of the waggon. Signed and numbered dye-line copies sent in postal tube for £3.30 ($10 for airmail to U.S.A.). My catalogue with illustrations of 20 vehicles is included, or is sent for 3 x 6$\frac{1}{2}$p stamps if ordered separately. *Callers by appointment only please.*

John Thompson,
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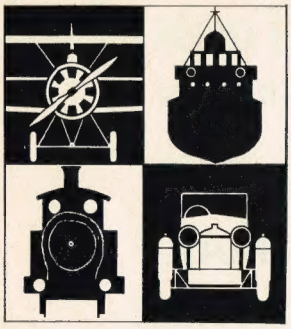


46th Model Engineer Exhibition

JANUARY 4-15th, 1977

(Not open Sunday)

at Wembley Conference and Exhibition Centre

LOCOMOTIVES, BOATS, AIRCRAFT, TRACTION ENGINES MILITARIA, WOODWORK, CRAFTS

The 1977 Exhibition moves to the brand new Wembley Conference and Exhibition Centre, right next to Wembley Stadium and the Empire Pool. It will be on two floors, each of which is greater in area than the total space available at our home for the last few years, Seymour Hall, and there will be over 100 trade stands and many society and association displays.

Conveniently situated just off the North Circular Road, between the ends of the M1 and M4, there is car parking for 5,000 cars (or 2,000 coaches) and there is the chance to combine a visit to the Exhibition with the ice show at the Empire Pool or the Christmas show at the new 2,700 seat theatre. Catering facilities are excellent—the Bridge Bar, in the Exhibition, seats 500, and there will be a snack bar and restaurant. Even if twice the numbers of previous years attend on any one day, there should be no real crush.

On the upper floor will be most of the engineering and marine stands and exhibits, including the S.M.E.E. workshop and track, plus a Gem Craft section (popular with the ladies!) while downstairs will be military modelling and wargaming, aircraft, the central display area (electric aircraft R/C cars and tanks, live steam traction engines, etc., etc.) plus, for the first time, a special Woodworker area, with famous tool suppliers, demonstrations, competition entries etc.

Throughout, demonstrations are planned, including lathework, brazing, milling, and other workshop practices, lapidary, enamelling, wargames, miniature weapon-making, cart making, wood turning and machining, boatbuilding—a real feast of how to do it.

COMPETITION CLASSES

Entries are invited in the following categories:

A	Locomotives. 2½ in. gauge and over.
A1	Locomotives—to any L.B.S.C. design 2½-5 in. gauge (including steaming).
B	Locomotives. In gauge 1 and 0.
BA	Locomotives. In gauges smaller than 0.
C	Rolling Stock and Accessories. Gauge 1 and 0 or larger.
CA	Rolling Stock and Accessories. Gauges smaller than 0.
D	Steam and Motor Ships of any period. (Non-working).
E	Power Driver Boat Models. (Complete with power plant). Scale or Freelance.
F	Sailing Ships of any period. (Non-working).
G	Working Yachts and Sailing Ships.
H	Hydroplanes and Speedboats.
I	Miniature. Length of hull not to exceed: 9 in. for ¼ in.—1 ft. scale or larger; 10 in. for 1/16 in. scale; 12 in. for 1/25 in. scale, 15 in. for 1/32 in. scale. No limit for smaller scales.
J	General Engineering Models (including stationary and Marine Engines).
K	Internal Combustion Engines.
L	Mechanically Propelled Road Vehicles (including tractors).
	(J, K, L: working models)
N	Tools and Workshop Appliances.
O	Engineering Scale Models (Non-working).
P	Scenic and Representational Models (including Architecture).
Q	Horological, Scientific and Optical Apparatus.
R	General Craftsmanship—not otherwise classified.
S	For any type of model (other than military) or mechanical work by a junior under the age of 16 by 31 December, 1976.
AA	Flying models of all types; (a) free flight, (b) control-line and (c) radio control.
AB	Scale flying models of all types, rubber, glider, power, control-line or radio control.
AC	Scale non-flying models.
AF	A piece of radio control equipment built to a design published in Radio Control Models & Electronics, Aeromodeller or Model Boats, from a commercial kit, or of original design.
MA, MB, MC, MD, MJ1, MJ2	Classes covering miniature figures, dioramas, artillery, etc, detailed on official entry form.

Junior Prize additional in each class with three or more entries. (Under 16 on 31st December, 1976).

Woodworker Section: WA Cabinet making; WB Wood carving; WC Wood turning; WD Musical instruments; WE Marquetry; WF Fretwork, pyrography, miscellaneous

Entries for these classes should use special entry form in September or October 1976 issues of Woodworker magazine. Note that these particular classes are open to both amateur and professional craftsmen.

In addition, there is a competition for hot air engines, a special classification for model boats built from a kit, and a one-subject Colonial 1857-1900 military modelling class. Details of all these in the appropriate magazines and/or on the entry information forms, available after mid-July. Loan (non-competitive) entries will also be considered.

This is *your* exhibition as much as ours, and we hope to have the favour of your full support—lots of models, volunteer stewards/demonstrators etc. to make this first major exhibition at the new venue a resounding success which will further the interests of modellers nationally.

COMPETITION ENTRY CLOSING DATE IS OCTOBER 18th, 1976

SMOKE RINGS

A Commentary by the Editor

Kew Bridge Engines

On 19 July last, one of the largest beam engines in the world was put into steam. Built 130 years ago, the 90 in. bore Cornish beam engine at Kew Bridge has been restored by members of the Kew Bridge Engines Trust. At each of its 11 ft. strokes, this beam engine lifts 620 gallons of water. In its prime, the engine provided West London with 6.5 million gallons of water per day.

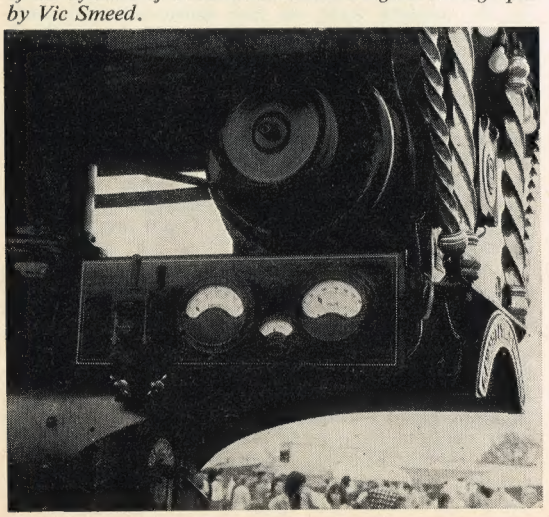
The restoration of Kew's engines began three years ago, when the Trust leased for 50 years the historic part of the Pumping Station from the Thames Water Authority (Metropolitan Water Division). Since then, the Trust has installed three boilers, dismantled, reassembled and restored to steam the 1820 Boulton & Watt engine, the oldest on the site, and has established the beginnings of a museum of London's water supply.

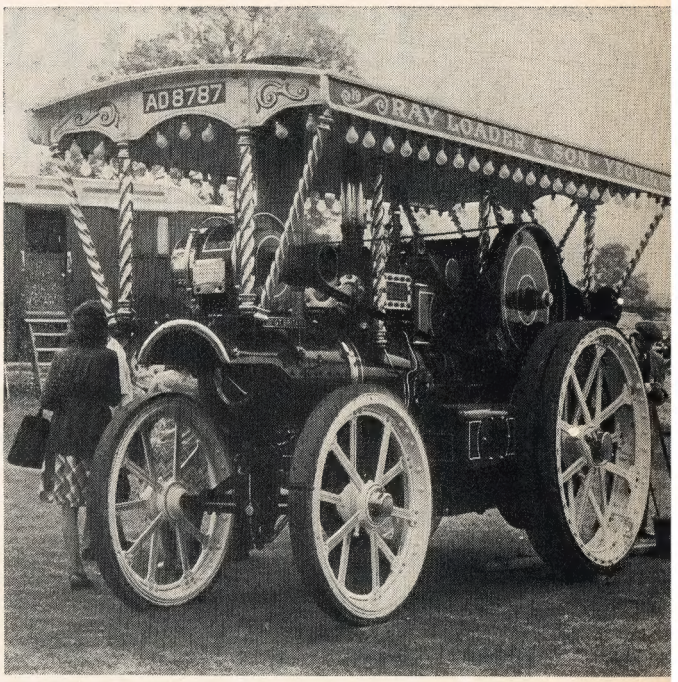
Brighton Museum Project

I hear that there is a scheme afoot to provide Brighton with its own Transport Museum. At a meeting held recently, it was suggested that the old Pullman car depot at Preston Park might be used. With the removal of most of the railway exhibits from Clapham to York, enthusiasts in the South will hope that the scheme comes to fruition.

Heading picture: A Garrett showman's engine at the Bath & West show.

Below: The ammeter and voltmeter recording the output of the dynamo of a Burrell showman's engine. Photographs by Vic Smeed.





IMLEC at Kinver

Enthusiasts who watched the proceedings at the Kinver International Model Locomotive Efficiency Competition must have noted how many of the competing locomotives suffered from severe slipping. No doubt the rails became greasy after some of the earlier competitors had completed their runs, and this may have been aggravated by the very hot conditions. But I think the basic reason for the engines "losing their feet" was the fact that the rails were of aluminium alloy rather than steel.

I know that many model engineering societies have used aluminium and seem quite happy with it, nevertheless I can't help thinking that steel is a better proposition, even though the rectangular section usually employed may not look so realistic. I don't think the argument that steel gives a rougher ride, or that the rust problem rules it out, is a very good one. The Southampton Society's track is a fine example of what can be done with steel rail.

Model Engineer Exhibition

With the *M.E.* Exhibition not so far away may I remind readers that our "Loan" section is open to models, finished or unfinished, which their owners may not wish to enter for the competition sections. Past Cup winners will of course be most welcome.

May I also appeal to readers for more entries for the Tool & Workshop Equipment section—generally a rather lean section.

1976 INTERNATIONAL MODEL LOCOMOTIVE EFFICIENCY COMPETITION

Reported by D. E. Lawrence

Bill Perrett from Southampton wins with his 5 in. gauge G.W.R. 0-6-0T

THOSE WHO ATTENDED IMLEC this year will probably remember it chiefly for the conditions in which it was held. A sweltering heat wave pushed the temperature up into the nineties and I took aboard more cold water on that day than I have ever drunk since being unceremoniously dumped in the North Sea more than 35 years ago! A very large crowd turned up and drank the restaurant dry and ate up all the ice cream. Two people were overcome by the heat and such were the conditions that I think the first vote of thanks should go to the Ladies of the Society who did such a magnificent job of the catering — they took over the restaurant of the Social Centre for the day and dispensed substantial cold lunches, sandwiches, tea, etc., etc., to a seemingly endless queue of folk.

A special small committee had been set up well before last Christmas for planning IMLEC 1976 with Alan Harris in the chair and Dick Harper as its Secretary. The other four members of the committee with Alan and Dick were given a special responsibility each, and it seemed to me the division of labour fell into the right hands as everything went along quite well.

Kinver's track when first built in 1970 was a sort of lozenge shaped regular oval about 700 ft. long. A year later it sprouted an extension loop on the north-east curve and it now measures 1295 ft. in length. Grades are quite modest; a 1 in 400 climb out of the station which is on a curve, followed by a short stretch of 1 in 110 down, thereafter the grades are easy up and down with a short stretch up of 1 in 217 to the station. In addition to the main station there is also Cowdrey Halt on the extension loop. Construction is substantial; the original track is built upon thick concrete pads up to ground level and on these are really solid deep concrete arches about 9 in. wide and about 6 ft. centres. The extension loop is of hollow concrete blocks in continuous formation. Upon the hefty base there are 1 in. thick timber bearers laid in line along the base with cross ties (sleepers) fastened to them. Rail is flat-bottom light alloy for the 5 in. gauge and the 3½ in. has one f-b brass rail, the other of course being common to the larger gauge. There is no anti-tipping rail fitted; the deep section base probably makes this safety device unnecessary. The rail is decently aligned and I was pleased to see that expansion problems had been well contained even in the exceptional heat wave; only one minor adjustment was needed at the traverser during the day.

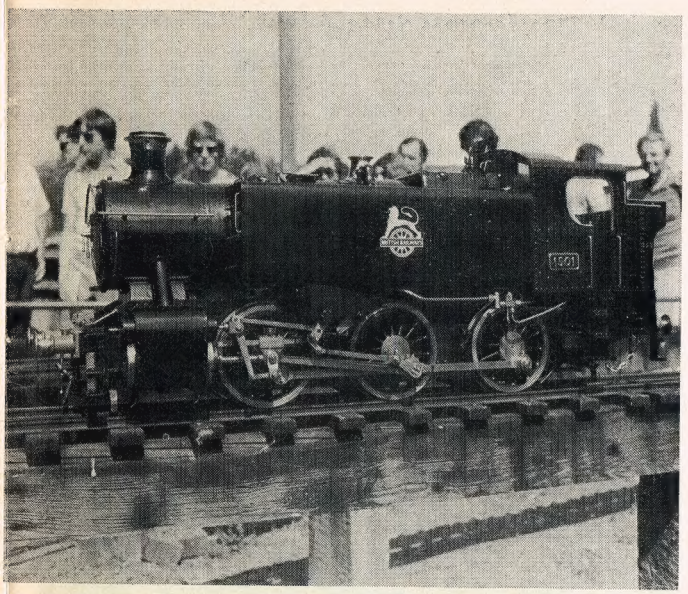
A rake of six bogie vehicles had been built, not specifically for IMLEC, but I gather that the Society needed them anyway and used the Competition as an excuse to spur members on with the project! However, although two of the six lacked a coat of paint, they *were* ready and in operation on the day, which was what mattered. The bogies were free running and had detachable 2 in. thick foam filled seats, quite luxurious. It turned out there was one rogue amongst them, of which more later.

Adjacent to the track site is a large hall with the catering facilities I have already mentioned. A fair-sized model engineering exhibition was staged in there. I only managed a quick look at the show and it was obviously comprehensive and of good quality. Further entertainment was laid on for the children in the form of free rides on a raised portable track in the centre of the picnic area. Billy Walker and a fellow member ran their 5 in. gauge tank engines on this in turns all day and not a vestige of shade for them at all. Another portable track, 7¼ in. ground level this time, was laid out in the sports field next to the track and the kids —large and small—given rides there.

The Society's Chairman, Paul Miles, ran the modern hi-fi p.a. system and was kept at it for the whole time. In the modern style we had music-while-you-melt, interspersed with an occasional announcement. Again in the modern d.j. manner, some visitors, Don Young and the two Cape Town members were introduced and interviewed over the air.

The official programme was well produced; it gave details of the Competition, what it was all about and a list of entrants, of course. I don't know who was responsible for it, but the front cover showed a humorous character of a 0-4-0 straining at every seam struggling to move a reluctant 1 ton weight on a sagging truck!

The Rules for the Competition had been printed in *M.E.* before the day so that all interested would be acquainted with them; in any case a copy of the Rules was given to each competitor on arrival at the reporting point. I was quite intrigued to see one Rule which forbade the use of a hand pump for getting water into the boiler unless in dire straits and which threatened to disqualify a locomotive which could not keep up water without hand pump assistance. The reason, of course, is that waggling the hand pump handle on the run may cause undue variation in recording the drawbar pull. I'm afraid I could not resist a tongue in cheek



The winning locomotive, W. Perrett's 5 in. gauge GWR 0-6-0T.

enquiry of Alan Harris if they were on my side and were getting people to make and fit Standard No. 1 or 1A injectors!

The usual conditions applied for the Competition; the winner would be the locomotive returning the lowest coal lb. per drawbar horsepower hour figure from which the overall efficiency would be obtained. The dynamometer car used on this occasion was that made by Eric Griffiths of the Bristol SMEE and which is not wholly mechanical, having some electronic apparatus fitted. A minor hitch occurred during the afternoon when it was thought the batteries were getting low, but this little problem was overcome with

Bill Perrett passing the steaming bays on his winning run.

little delay. The Bristol car has been in regular use for a couple of years and the results obtained with it at this Competition are consistent with those obtained in the past from the Birmingham car. Eric's car has capacity to absorb and record up to 100 lb. drawbar pull, nearly twice as much as the Birmingham car, although no competitor has so far managed to reach so high a pull.

Now we come to the matter of coal; anthracite beans were used and I fear our winner was distinctly concerned about that. In fact, Bill Perrett got chaffed unmercifully about it, of which more later. For lighting up, each competitor was allowed as much charcoal or wood as needed to make a fire and he could change to coal whenever he thought fit. All the coal used was debited to the engine and, a new rule this, a good coal fire had to be burning before going on to the main line.

This is the first Competition in which an overseas entry, as distinct from driver, appeared and the two South African model engineers who had entered a model S.A.R. locomotive, were given a warm welcome at the track. Another overseas guest was Ken Tinkler of Melbourne, Australia. He told me that the South Australia SMEE will be having a 50th birthday next Easter 1977 and a big Convention was to be held in Adelaide to celebrate the occasion. Would I, said Ken, get a plug in the *M.E.* about it? I would and did! I also met Mr. Van Den Bossche from Brussels who regretted the scarcity of model engineers in Belgium and perhaps I might say something—so I have! Lastly I met John Caldwell of Pennsylvania, U.S.A., of the well-known Pennsy Club which needs no plug.

Our day began soon after 8 a.m. for a start at 8.20 a.m. but unhappily most of the possible passengers were still a-bed and it was not until nearly nine o'clock that the train could be made up to the load required, in spite of impassioned pleas over the p.a. system.

1st RUN. Mr. S. Baker of the Derby SME was the early bird with his good-looking *Eva May*, a 5 in. gauge pre-war LBSC design. This chunky 0-6-0T has two outside cylinders with Baker valve gear and it is finished in a medium green and black livery and lined out; a nice neat job it is too.

He took as load driver, observer and 16 passengers, of whom four were youngsters. The start on the sanded rail seemed uncertain; the engine had a pronounced shouldering action and the exhaust was very sharp. The first lap was taken carefully at a slow speed then went up to about 5 to 6 m.p.h. At different points on the track the driver tried to pile on more steam but this only resulted in violent slipping of the wheels; towards the end of the run progress was rather laboured. I looked at the contents of the smokebox after the run and there was the usual char and also some splinters of unburnt coal, a circumstance which attracted more than one person's interest.

Changing engines was fairly slick; the locomotive which had finished its run was uncoupled and run forward past the traverser which was then lined up with the siding and the next entrant came on and ran back light to the train. While that was being done, the previous entrant was backed on to the traverser and was switched to the siding, then the main line was restored. Average "turn-round" time was about 5-6 minutes.

2nd RUN. I had met Rugby member Fred Winsall's 5 in. gauge GWR *Manor* before and I told Fred that I thought he had about an even chance. His 4-6-0 is straight *M.E.* and it has slide valves; total engine

weight is about 175 lb. and I estimate about three-quarters of that is on the drivers. The *Manor* is finished in the correct style of plain unlined green and black and all about it is clearly workmanlike without any frills.

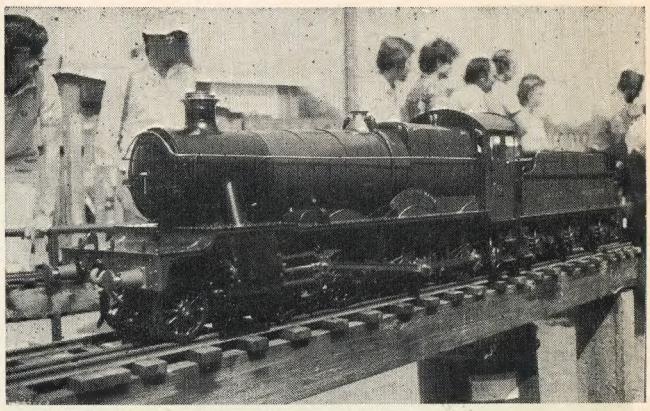
Load was driver, observer and 10 passengers and Fred made a clean start on sanded rail out of the station. Thereafter the train worked up to about 10 m.p.h. and I think Fred must have had a warning tap on the shoulder to keep speed down a little as most of the run was subsequently at about 8-9 m.p.h. There was very little loss from the safety valve and Fred's handling of his locomotive was most able and he drove it into 2nd place.

3rd RUN. Bertie Green is a friend and he had one of the three LNER B1 *Springboks* in the Competition. Bertie was representing the Chichester SME. The locomotive is straight *M.E.* with only minor modifications to the steam and water lines to accommodate Standard No. 1 injectors. The engine is well looked after and is in good condition. I believe I have mentioned before that it is somewhat "light on its feet" and the load was limited to driver, observer, plus 8 passengers. Sanding of the rail was allowed only at the start of the run, also, if any competitor wanted to change the composition of his load he could only do it before commencing the second lap. Bertie had difficulty in starting the train, there was plenty of slip but no forward movement. He backed up a couple of times and more sand was applied until *Mayflower* eventually got clear of the station and began accelerating down the straight from the steaming bays and on to the long straight leading to the new loop. Here speed began to drop and, sadly, Bertie had to stop for a few minutes in the station where pressure was restored. He did not lighten the load and managed a slippery getaway from the stop. Thereafter speed picked up and he ran several decent laps until the last, when speed again fell away.

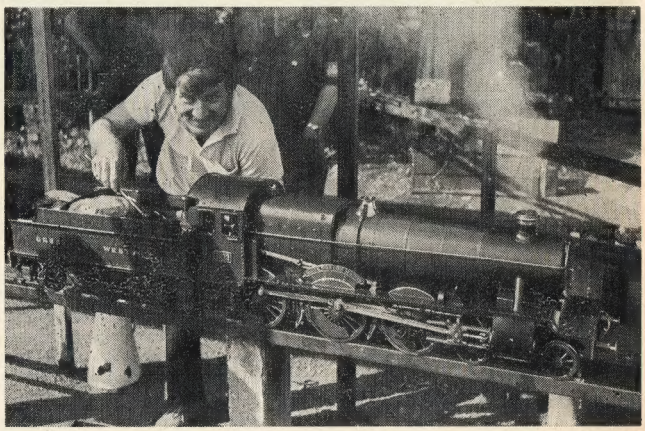
4th RUN. The two Cape Town SME members are friends of Bertie Green who had already given me some idea of what the model S.A.R. locomotive was like. Although it is 1 in. scale of a 3 ft. 6 in. prototype, in fact it is a fairly small locomotive with a small boiler and it does not look any bigger than a $\frac{3}{4}$ scale model of a modern standard gauge 4-6-0. Jack Love very kindly gave me a potted history of the full-size details and of the model which I can do no better than to quote here; he writes: "The 6th Class locomotives appeared in 1893, being built for the Cape Government Railway. Although primarily intended for passenger train duties, this class, designed at the Salt River workshops in Cape Town, proved very reliable, good steamers, fast, easy to handle and maintenance was surprisingly minimal. In the circumstances it is not surprising that these 'maids-of-all-work' found their way on to every line and yard in the country. Sixteen were used in the Middle East during World War II. Various orders totalled 220 and for many years these engines were the backbone of the S.A.R. The general specification was 4-6-0 wheel arrangement, initially plate but towards the end bar frames, 4 ft. 6 in. coupled wheels, wet steam and Stephenson link valve gear. Averages for the class were a tractive effort at 75% - 17,000 lb. and weights in working order of the engine and tender of 48 tons and 33 tons respectively. Makers included Dubs & Co., Neilson Reid & Co., Sharp Stewart & Co., Kitson & Co., Baldwins and North British. The last order was in 1904.

"The 1/12 scale model was built by Jimmy Scott in 1965 and sold to Jack Love in 1973. The object of the purchase was to pair it with the 25NC class that the present owner is currently building. They contrast to show 60 years of S.A.R. locomotive development most effectively. Valve gear is Stephenson with launch links. Lead is .010 in. in mid gear and lap 3/32 in. per side. Cylinders are $1\frac{5}{8}$ in. bore with $1\frac{1}{4}$ in. stroke. Twin safety valves are set at 80 lb. and steam is superheated in 6 elements. The narrow firebox has a grate area of $16\frac{3}{4}$ sq. in. and the stainless steel firebars are $\frac{1}{8}$ in. thick at $\frac{1}{8}$ in. spacing. Water feed is either by axle pump or an injector to Scott Mk. 2 design. An additional boiler insurance is a twin-cylinder hand pump in the tender. The lubricator incorporates a spring clutch drive. To date the engine has done about 300 miles and has appeared on most of the club tracks in South Africa. The only preparation for the IMLEC has been a general clean up, servicing the safety valves and the fitting of a new injector. No other parts have been renewed."

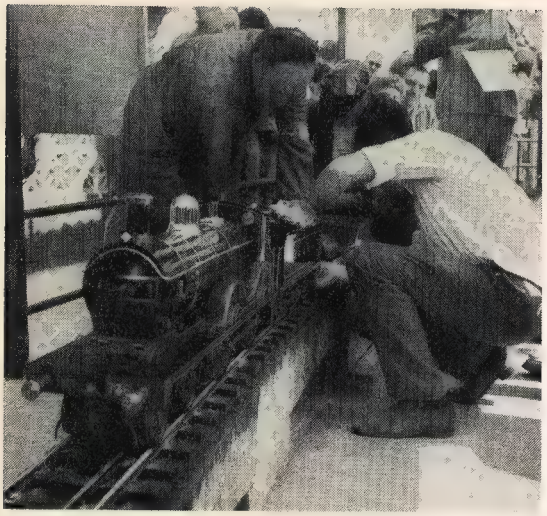
Load for the run was driver M. Busbridge, observer, plus 6 passengers and the start was accompanied by a good deal of slipping; so much, in fact, that Mr. Busbridge had to set back three times before he got away several minutes late. The run was made at a modest speed around $6\frac{1}{2}$ to 7 m.p.h. with the safety valves lifting frequently. Both the Cape Town chaps thoroughly enjoyed their experience and were full of praise for the track. the ride, the host Society and the coal—particularly the coal, which was better than the stuff they could get at home. Oh well, one man's meat . . . !



Fred Winsall's handsome "Torquay Manor" came in second.



Fred Winsall raising steam in his "Manor".



John Coleman's very attractive 5 in. gauge SECR 4-4-0 was third.

5th RUN. Matt Jeffries of the Cannock SME made this run with his LMS 2-6-4T *Jubilee* which is a 3½ in. gauge engine to Martin Evans design. Matt had made some modifications and had fitted valve spindle guides, a larger boiler, modified two-stage blast pipe, large exhaust ways and he had rearranged the bunker layout to his own liking.

Load was driver, observer and 4 passengers which I thought was about the right capacity for the 2-6-4. The start was somewhat better than those of some of the heavier locomotives and *Jubilee* was soon going at a fair lick; 4 laps were run at about 8 m.p.h. and I thought we would see a really good run. With about 10 minutes or so left the train came to a standstill on the extension loop. Unfortunately a screw holding the leading right hand crank pin washer had worked loose and this fouled the crosshead and bent. Under the Rules Matt had to retire. I thought this a great pity; the engine had been going really well and had been lapping consistently in capable hands.

At every past IMLEC I have usually managed a few minutes chat with each competitor, but I'm sorry to say I could not find enough time to talk to them all this year. The layout of the track was such that I had

P. Wood's 5 in. gauge "Maid of Kent" ran well to finish fourth.

Laurie Joyce, last year's winner, was fifth this time, with his 3½ in. gauge "King".

to walk a fair distance between steaming bays where my "customers" were and to convenient spots from which to take photographs. Also, having had some of this tropical heatwave skylark before, I went into the clubhouse very frequently and drank copiously from the cold water supply there. I must also confess to succumbing to temptation when Wilf Carter, President of the Witney & W.O. SME, waved a bottle of one of my favourite brews under my nose. The contents went down with gratitude; a very, very understanding chap is Wilf who repeated his generous tempting act twice more during the day. Never again will I cast an aspersive eye on the alignment of the Blenheim track. So on to the . . .

6th RUN. Made by John Richardson of the Keighley SME. He has a 5 in. gauge 0-6-0 *Minx*, a 30-year-old design by the late LBSC freely based on the old SR *Vulcan* goods. John has the Joy gear version which is the better of the two alternatives LBSC gave. There are no departures from design and the engine was finished in a plain glossy black livery. John said he used anthracite on his home club's track and was quite happy with it here.

At first the load was driver, observer, plus 11 passengers, but *Minx* had severe slipping troubles in getting away and had to back up and try again on freshly sanded rail. The load was reduced by two passengers and *Minx* eventually got away to make a good run, lapping the track steadily at around 8½ to 9 m.p.h.; this was another competent performance. John finished with his face liberally spotted with sooty oil and the footplate covered in spilt coal.

7th RUN. There were four coach loads from clubs including the Bristol contingent whose representative was John Coleman's South Eastern & Chatham Rly. D Class 4-4-0 in 5 in. gauge. It has two inside cylinders, express diameter wheels, is very well made and looks very handsome in its ornate light green lined out livery. A friendly rivalry exists between John and Mike Smart who was to run later. Apparently in trials between their Societies. Mike's Compound was just

beaten by John's D Class and Mike was determined to reverse that order and I fancy John was equally determined he wouldn't!

The load was driver, observer and 8 passengers, but when John ran out of sanded rail, the engine slipped to a standstill and the load was reduced by 2 passengers. Careful handling by John got the train moving again and he went on to lap the track fairly steadily. One lap was somewhat slower than the rest, but speed was generally up to about 8 m.p.h. This was a good consistent run and it was given a round of applause at the finish. John Coleman came in 3rd place.

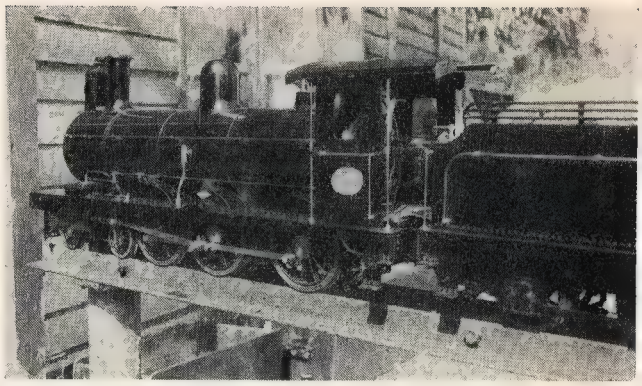
8th RUN. Albert Sell was having a third attempt at IMLEC and this was the second try with the same locomotive as last year. His club is Chesterfield and his locomotive is a 5 in. gauge model of a Hunslet 2 ft. gauge 0-4-0ST; it bears the name *Gwynedd*. Albert said the only alterations made to the engine since last year were to the blast pipe.

Load was similar to 1975, driver, observer and 9 passengers, of whom 3 were youngsters. Albert made a decent start and a good trouble-free run; speed was generally about 7½ m.p.h. with little variation. Afterwards he said that the locomotive had not steamed quite so well as anticipated and he thought this was due to the blast pipe alterations. If it is any consolation to Albert his engine's performance was very little different to last year's. The loads were closely similar at 10 adults; distance run 21,327 ft. (1975), 18,130 (1976), work done 406,230 ft./lb. (378,000 ft./lb.), average d.b.h.p. .401 (.38), coal lb./d.b.h.p.hr. 18.12 (18.43), overall efficiency 1.003 (.98%), placing 7th (1975), 8th (1976)

9th RUN. I had seen the fine LNER B1 of Neville Sanderson, the host Society's entry, at Witney & W.O. Open Day a few weeks before and had been impressed by its obvious good looks and good workmanship. Although the boiler is to the *M.E.* design, the cleading is formed into Belpaire shape and, I think, it looks the better for it; otherwise the engine is straight B1. Neville had made alterations to the footplate and had produced a well detailed but functional layout of the controls. Mechanical oil pumps are fitted and these have sight feed glasses located in the cab on the delivery side, one to each cylinder. The LNER livery and lining out was well done.

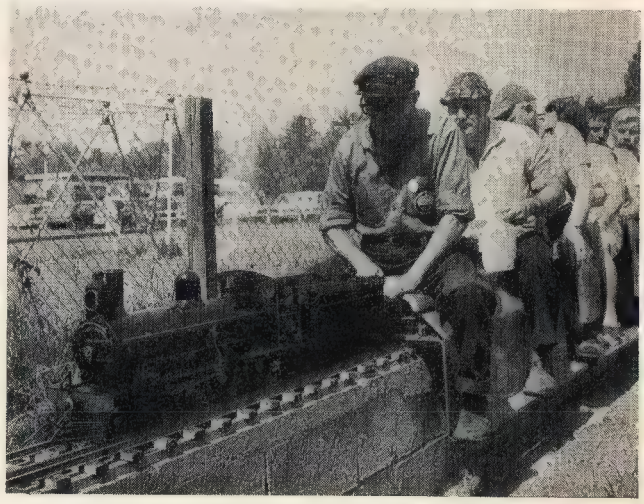
Load was driver, observer and 10 passengers and Neville got his train away to a clean, albeit very careful, start. For about 20 minutes we saw a good run with firing and water feed at regular intervals, then *Dalesman* slowed to a stop. My observation was no steam and no water and it took 4 or 5 minutes for Neville to restore matters. This was a great pity as he had done well up to then. This engine returned the best performance of the 3 B1s with an overall efficiency of .97%.

10th RUN. This was made by another good looking locomotive belonging to Mr. E. V. Harrison of the Wirral Society. He had made his GWR *City of Truro* to his own drawings in 1962 and had put on a fair amount of detail. The 5 in. gauge engine has two 1⅝ in. by 2⅛ in. inside cylinders. Stephenson's valve gear and a radiant superheater. The driver was Harry Roberts, a friend of the owner, and he took a load of driver, observer, plus 7 passengers. The start had the usual bout of slipping and there was plenty of wheel slip on the run. The *City* had a fine turn of speed at times but unfortunately it slipped to a standstill just past the station. It was rather sad to see the locomotive just standing there with the coupled wheels going round without any forward motion. After several attempts to induce the train to move, the *City* was retired.



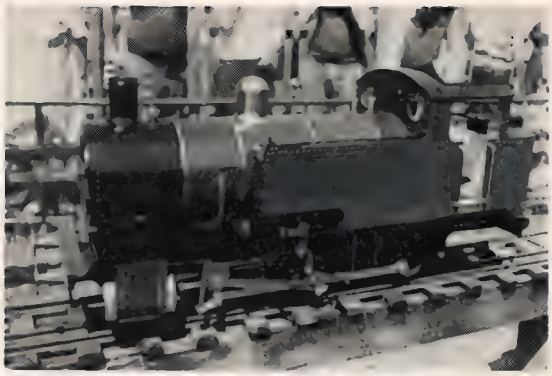
The South African entry, built by Jimmy Scott in 1965.

Below: M. Busbridge drives the South African 1 in. scale 3½ in. gauge 4-6-0.



Below: Mike Smart driving his very attractive 5 in. gauge Midland compound. He took seventh place.

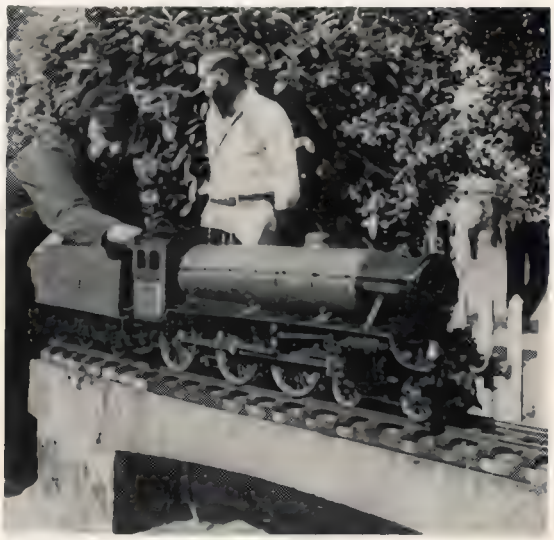
A. H. Sell from Chesterfield driving his N. G. Hunslet saddle tank locomotive.



S. Baker from Derby drove his 5 in. gauge 0-6-0T "Eva May"—an early LBSC design.

Neville Sanderson of the Host Society with his modified "B1".

Below: A 5 in. gauge "Minx" 0-6-0 driven by J. Richardson from Keighley.



Dr. Hollins driving Mr. Nadin's 5 in. gauge "Springbok".

Below: Bertie Green with his "Springbok" in BR livery.

There was now a call for some stewards to clean up the track and one kept crossed fingers that the next competitor might fare better.

11th RUN. Now John Coleman's rival took the track; the 5 in. gauge Midland Compound 4-4-0 of Cheltenham member Mike Smart has been a contender last year when it had suffered the misfortune of losing part of its blast pipe. There had been no alterations to the locomotive since we last saw it, though I suspect the blast pipe might have received some "security" treatment. I also suspect Mike had taken note of the amount of slipping by previous runners and had gauged his load accordingly.

His load was driver, observer and 5 passengers, but even so, he had to back up at the start before being able to make a very careful and clean getaway. He gave us a good run to watch with speed averaging around 8½ to 9 m.p.h. The engine had a clear and even exhaust and sounded in really good nick. Performance was quite steady and, although he did not overtake the SECR D class, he deserved the applause given at the finish of his run.

12th RUN. I built one of the first *Speedy*s in the country and when we officially opened our first continuous track at Bournemouth Bill Perrett had a long spell on my *Speedy*'s footplate. He practically had to be prised off it. He was so taken by it that he promptly started to build one himself. His own GWR 5 in. gauge 15XX 0-6-0PT is now in its 13th year of service and, because it is one of the regular workhorses of Bill's own Society at Southampton, it has had much rebuilding and replacement of worn parts since new. Currently it has a 100 lb. p.s.i. boiler, the cylinders are 1/16 in. less in diameter at 1½ in. bore and what Bill calls a semi-radiant superheater is fitted, that is extending into the firebox for only half its length. I have already mentioned Bill's apprehension about the coal being used and his own previous experience at Blenheim and reports of the behaviour of these types of anthracite did not fill him with all that much confidence.

He kept his load to a reasonable one and took driver, observer and 10 passengers. The start was very, very cautious indeed with the wheels just on the point of slipping, but Bill's canny hand kept careful control and *Speedy* did not lose its feet. Bill took his time about accelerating, evidently waiting to see how things went before opening up. After the first lap speed rose to about 8½ to 9 m.p.h. and varied little from that. The run was good and steady and the train rolled with an assured and confident *Speedy* at its head. One could see Bill was quite satisfied with the way things were going and it was also obvious he was enjoying himself.

After the result was put up showing the 15XX in the first place at that time, I must say I felt a deal of sympathy for Fred Winsall. Last year he held on to the leading position for over 4 hours before being knocked off the perch. This year over 5 hours went by before he was relieved of the number one place. That's all part of the Competition, I suppose.

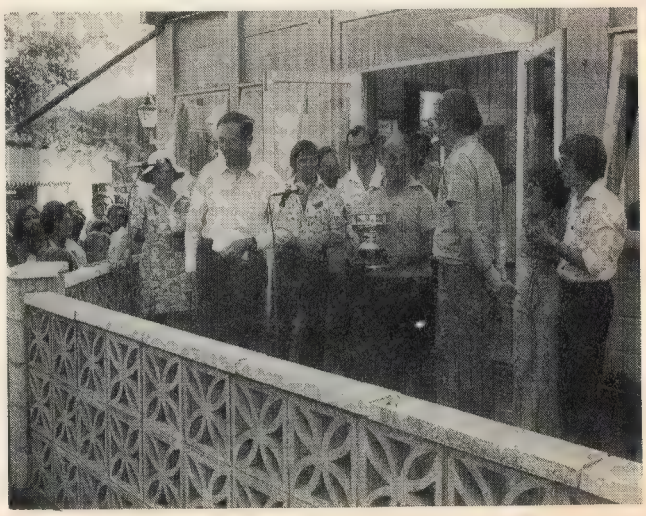
13th RUN. The superstitious will say it was bound to happen; Mr. F. Nadin's LNER B1, the third of this class to run, was in charge of J. B. Hollins who set off with a load of 10 in all and several minutes after the start the train came to a standstill on the approach to the station. The B1 was slipping badly and refused to get hold of the train at all. While the driver was having a look round to see what was amiss, an urgent call came over the p.a. for any doctor in the crowd to come to the clubhouse. The call was repeated

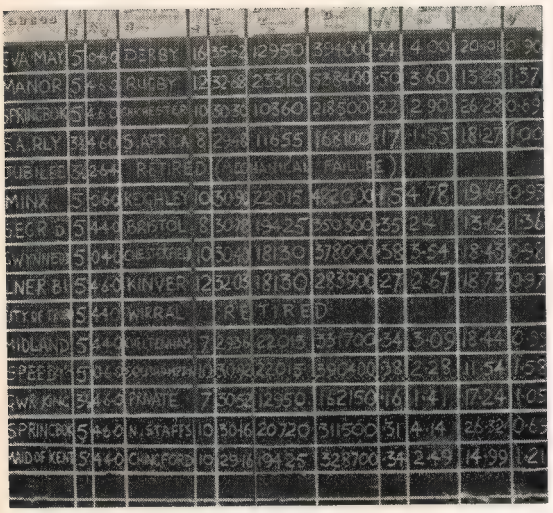
Matt Jeffries of the Cannock SME was very unlucky to have a crankpin screw work loose, after a promising start with his 3½ in. gauge "Jubilee".

a couple of times and it took a little while for people to realise that the only doctor was the driver of the train; at the same time it was discovered that the rogue passenger car had a seized bogie. Off went Dr. Hollins to attend to an acute case of heat exhaustion in the clubhouse while stewards attended to the train. The B1 was given another run later, of course. I was told the sick man was committee member Chris Plant who had been on duty in the sun all day.

14th RUN. Laurie Joyce was the 1975 winner and had again entered his 3½ in. gauge GWR *King* 4-6-0, this time as a private entry. There have been no alterations to his engine since last year and he took the same load of driver, observer and 5 passengers. He made a cautious start and the first lap was rather slow; one passenger was dropped at the end of this lap. It is possible that his fire had not been thoroughly prepared due to his hasty call because of the previous

The Hon. John Gretton presents the trophy to the winner, Bill Perrett.





A photograph of the scoreboard.

run's premature termination. However, with the reduced load the *King* set off again and reeled off a few more laps in good style but then speed varied a good bit, the last lap being distinctly slow. The *King* came in 5th place which was no disgrace.

15th RUN. This was allocated as the re-run for the North Staffs. entry, the LNER B1 owned by Mr. F. Nadin and driven by Dr. Hollins. The p.a. announcer asked for the same passengers to make up the load again and this was driver, observer and 8 passengers, of whom 2 were youngsters. On the first lap there was a derailment and this was quickly attended to. The re-start was accompanied by a lot of slipping but Dr. Hollins persevered and got the B1 going well. Laps were fairly consistent about 8 to 9 m.p.h. and there was free escape from the safety valve—all good steam going to waste and doing no work. I noticed the good doctor tapped down the safety valve spindle with his shovel, an all too frequent and in my opinion, deplorable practice.

16th RUN. The last run of the day and Percy Wood of Chingford was to make it with his 5 in. gauge *Maid of Kent*. The *Maid* is a somewhat underrated locomotive, I think, and it may often be found gallantly tackling loads beyond its nominal capacity. LBSC gave 3 alternatives in the design, offering a choice of 2 i/s cylinders with i/s Stephenson's gear, 2 i/s cylinders with Joy gear or 2 o/s cylinders with i/s Stephenson's gear. The best performer of these is the Joy gear version, which is the one Percy Wood has. I had previously met this *Maid* in the LBSC Memorial Bowl Competition early this year where I found it was typical of the breed. This *Maid* had a reluctance to notch up decently, but left in full gear and with load approaching thrashing point, it would work very well.

Load for the run was driver, observer, plus 8 passengers including a boy. Percy had only a little trouble in getting away from the station and soon had the *Maid* going at a decent speed. There was what I call the usual Curly chonk from the chimney and the train rolled along steadily making consistent laps. Percy's handling of the locomotive was confident. competent and unflurried and he drove his *Maid* into fourth place.

In a short while we gathered round the clubhouse patio to hear Martin Evans acknowledge his appreciation of the hosts in staging the Competition. The Chairman thanked everyone who had worked for IMLEC and made it possible and those who had taken part. The ladies got a big mention, of course. The Hon. John Gretton, who was to present the prizes, was introduced; he is a live steam enthusiast himself and operates the Stapleford Park Miniature Railway. After the presentations he made a lighthearted speech about our hobby.

The prizes were awarded as follows:

1st	W. Perrett, Southampton	5″ g. GWR 15XX 0-6-0PT
2nd	F. G. Winsall, Rugby	5″ g. GWR 78XX 4-6-0
3rd	J. Coleman, Bristol	5″ g. SECR D cl. 4-4-0
4th	P. Wood, Chingford	5″ g. *Maid of Kent* 4-4-0

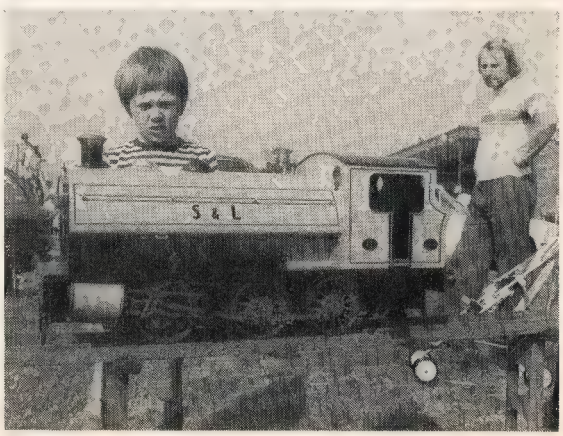
Anybody looking into the clubhouse after all this would have seen raised glasses of cool drinks while Kinver's efforts were applauded by their guests.

Now, that coal; I see I first mentioned about the behaviour of coal in the Competition in 1970 and it was Bill Perrett's experience with it which occasioned my comments then. I again mentioned the matter in 1972 and also last year (both IMLECs were at Newcastle) when Bill Longstaff gave me some information about water being trapped in the semi-anthracite used and I said *'we ought to slowly dry the stuff out before using it'*. Perhaps I was a little naughty in twitting Bill about his concern, may he forgive me. In the steaming bays was Dick Harper presiding over the coal "depot" where plastic bags each containing 1 lb. of anthracite beans were stacked on a table for ALL to see. The evidence which would have set any competitor's mind at rest was plain—the water was evaporating out of the coal and settling on the inside surface of the bags. Martin and I had noticed this earlier and had discussed its implications. After the first two or three runs, nobody had much by way of unburnt splintered coal in the smokebox.

To give Bill his due, when he received his prize he acknowledged that the coal was better than he thought it would be and he got a cheer for that.

My chief impressions of the day were of a very good humoured crowd and the excellent spirits shown by the Kinver members who all did their best to ensure that everybody enjoyed the day; lastly I must add my personal thanks for the very hospitable and helpful attitude towards me by the Kinver members.

At the opening of the Bedford Society's clubhouse: A Hawthorn Leslie 0-6-0T by a Corby MES member.



A RHOMBIC DRIVE STIRLING ENGINE

Part II

by Andrew Ross of Ohio, U.S.A.

From page 762

C. Connecting Rods

The con rods were made of 2024 alloy (a very good machining and extremely strong aluminium alloy). Both holes in each rod were drilled and reamed while clamped on the trued surface of a jig. The same side of each rod should be facing the jig for each operation, to assure parallelism. This is probably going a bit far, but it is no extra trouble, and is generally good practice. For the second clamping, the rod is mounted on a dowel pin in the jig, for locating. All in all, this is very much like the crank disc operation. My jig's locating dowel pins are always removable (slip fits) so that a new true face can be put on the jig each time it is clamped in a new position. I use 2024 for jigs because I like the surface finish it takes.

Once the holes were completed, the rods were finished with a horizontal mill, and a file. Some readers may wish to slot the ends for additional lubrication.

D. Yokes

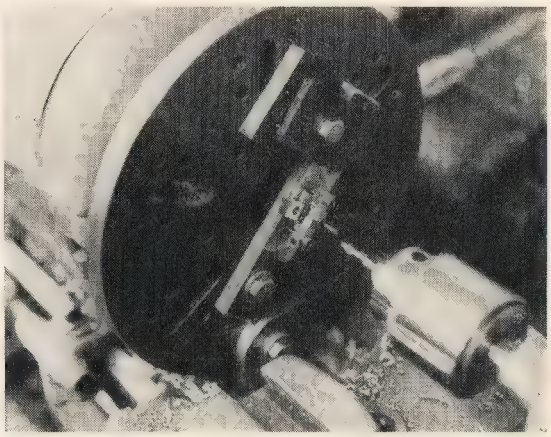
The yokes are crucial, yet surprisingly easy to make. As usual, I used my favourite aluminium, 2024. A bar $\frac{3}{8}$ in. x 1 in. was mounted lengthwise in the 4-jaw chuck. The end was faced, the centre hole for the displacer rod was drilled and reamed, and a light cut was taken off the side, just enough to expose bare metal on both sides. These would later be used for locating the piece on yet another jig. By this method you get a "bottom" and two "side" surfaces that are true with the centre hole.

The jig in this case is merely a little block with another piece jutting up at a right angle, mounted appropriately on the faceplate. The workpiece is located by pushing the bottom against the block and sliding it over to meet the other piece jutting up. Then the workpiece is merely flipped over and mounted the same way for drilling and reaming the other hole. This is guaranteed to get both holes the same distance from the centre hole every time. As mentioned before, this uniformity is far more important than that the centre distance between wrist pin holes be exactly $\frac{5}{8}$ in.

E. Bearing Supports

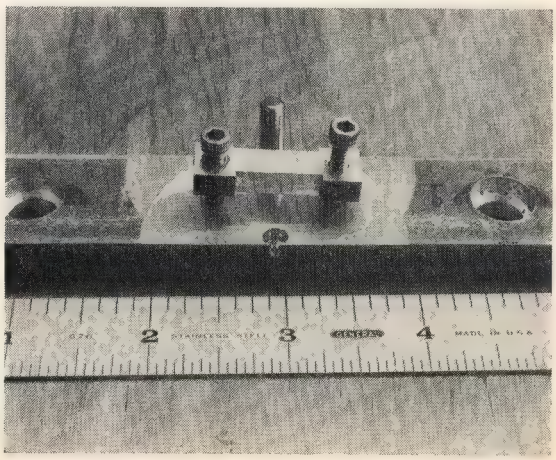
These are out of 1 in. square 2024 bar stock. I used needle bearings since they help keep friction down, an important consideration with overhung crankshafts. Actually, I suspect one could get along fine with only the inboard bearing needles, leaving the outboard bearings a plain reamed hole, but one would want to relieve some of the hole between bearings in this case, to allow for minor misalignments.

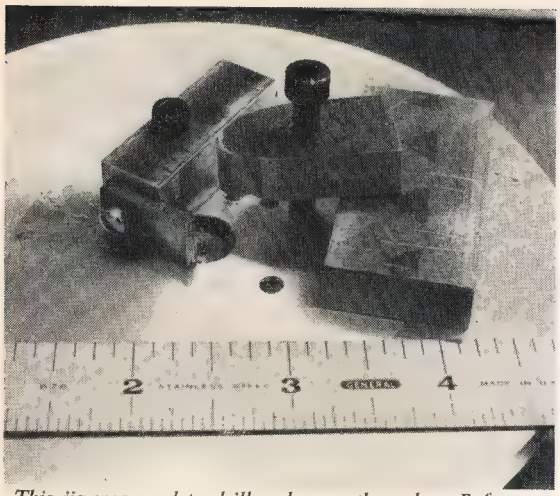
Unfortunately, needle bearings have to be pressed in, and I didn't have a suitable reamer, so I had to accurately bore the holes. This is one case where epoxy won't help, since the bearings take their appropriate size and shape from, and only from, being pushed into the right size hole. Believe it or not, these are the only parts I had to make over, due to my aggravating habit of "taking just one more fine cut before measuring it again".



The connecting rod jig mounted on the faceplate. All dowels are removable, allowing a true face to be cut on jig after clamping to faceplate.

Below: A close-up of the con-rod jig.





This jig was used to drill and ream the yokes. Reference was on each yoke's rounded sides and bottom.

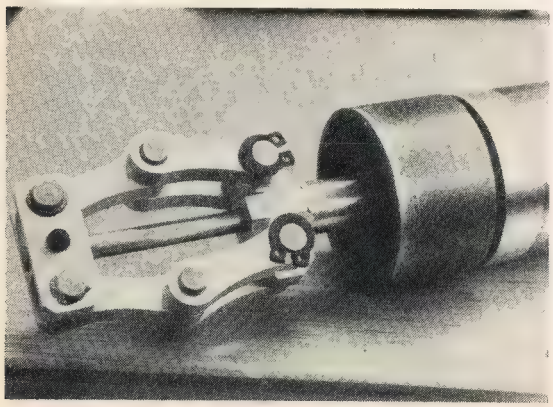
Needle bearings tend to be a bit noisy, and some readers may prefer to use ball bearings to eliminate this source of noise. Ball bearings would also allow the use of unhardened shafts, as well as epoxy.

F. Piston and Cylinder

The piston is cast iron. It is carefully epoxied onto the appropriate yoke. Obviously, great pains must be taken to assure it is true with the yoke. I did this by first mounting an aluminium flange on the yoke stem, then running the yoke between centres and truing the flange. The piston was cut without re-chucking, so its sides were true with its hole and the bottom of its top (if that makes any sense).

Of course, you may wish to attach the piston with screws: but be careful as this presents another sealing difficulty if the screw holes go through the piston and flange. These small leaks are the worst kind, as they allow an engine to run (poorly) and thus may go undetected, but they actually cause great pumping losses.

Below: The rhombic drive mechanism is indeed elegant. Self-locking retaining rings can be seen on the power piston yoke.



The cylinder is steel. I would like to have used some free cutting leaded variety, but had only good old 1020 (mild steel). Consequently, I had to hone the cylinder to get a good finish. Cast iron would be excellent for this. In any case, I would make the piston first, and then fit the cylinder to it. Clearance is crucial; I would keep it under .001 in. If it ends up a trifle tight, you can always hone the cylinder a bit more. In any case, in a high compression engine such as this, excessive leakage ruins engine performance.

G. Preliminary Test

At this point you can probably wait no longer to see if all your jig work is worth a hoot. So, if you get some suitable gears, and make the appropriate wrist pins and displacer rod, you can mount the shaft rods and yokes in the crankcase, and see how it turns over.

Be sure the displacer rod is through *both* yokes, as it supplies necessary support. There should be absolutely no binding at all; if there is, check and see that the cranks are geared together accurately.

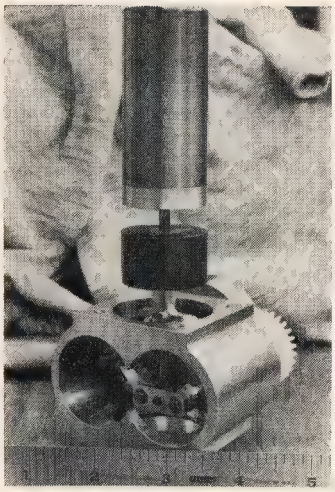
Assuming all goes well, and it really will if you used jigs, then the true test, the very scary moment of truth is at hand: take the cylinder and set it over the piston and into the crankcase, then turn one of the cranks. Again, there should be absolutely no binding and very little friction. At this point you will be very pleasantly surprised; for this seemingly improbable collection of cranks, rods, yokes, gears and shafts runs together with a smoothness and grace that belies its complexity. At this point you will no doubt spend about a half-hour alternately watching the movement and running about the house trying to find someone new to show it to! This may sound exaggerated, but wait until you've done it, and see.

H. Displacer Cylinder

This is a simple job, indeed. Mine is made of 2024 with cooling fins milled in vertically so the natural air currents will provide some air movement. If water cooling is used, as I would recommend, be sure to make all parts of the jacket of the same material, to avoid galvanic action.

I. Hot Cap and Displacer Cap

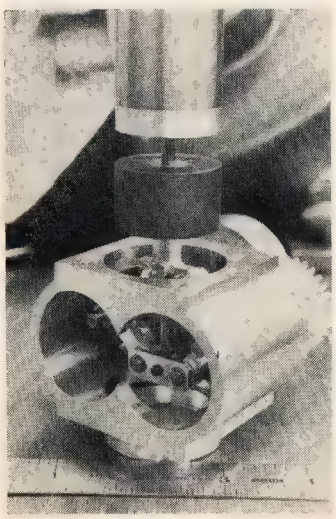
Both of these parts are of stainless steel. The hot cap is a machined disc welded onto a piece of .050 in. wall tubing, and the displacer is deep drawn from .020 in. sheet. I obtained these parts from William Beale in Athens, Ohio, whose company, Sunpower, Inc., does research and development work on the free piston Stirling engine. These are stock parts from the small demonstrator free



Left: Even without the cylinders surrounding them, the pistons move true and straight without any binding whatsoever.

piston engine Sunpower makes, and they were in fact the original inspiration for this rhombic drive engine. I subsequently machined the hot cap to a .018 in. wall, and the displacer cap to .012 in., to reduce the heat leakage. If I were starting from scratch I would start with thinwall tubing (perhaps .010 in. for both, and (high temperature) braze thin machined caps on to them, or, alternatively, machine both parts from bar stock (brass or stainless). For the experimenter an even better idea may be electro-depositing.

In this process, a male form is machined from aluminium alloy, and nickel plated to the desired thickness. Flanges can be added as desired, before plating, and they will become part of the finished part. Then the aluminium is chemically etched away, leaving the finished part. I have no experience with this process, but surely some readers have, and would pass on useful information. The big advantage is that the displacer dome could be made *very* thin (.005 in., for example), be very light, and leak very little heat. The same applies to the hot cap; also, a milled finned section, and foot flange could be plated into the structure. If a builder is going for maximum efficiency, this extra thinness will be a very material improvement. Such an engine should literally "run on a candle". Before doing this, one should do some research to see if nickel will hold up under the high temperature and not present any health hazard (toxic fumes, etc.).



Left: Another view of the pistons and the crankcase.

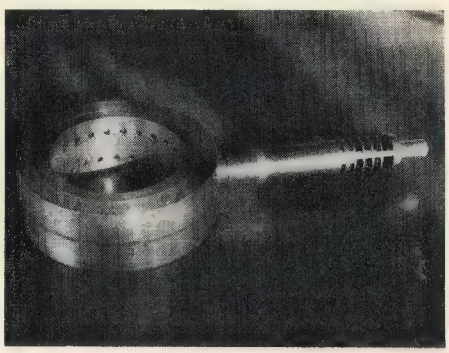
J. Miscellaneous Parts

The displacer consists of the cap, described above, epoxied onto a very thin 2024 bottom, which is in turn epoxied onto a 5/32 in. steel rod. A set screw attaches the rod to the yoke. The displacer height is adjusted so the displacer is 1/32 in. above the piston at its closest (i.e. when the crankpins are closest to each other.

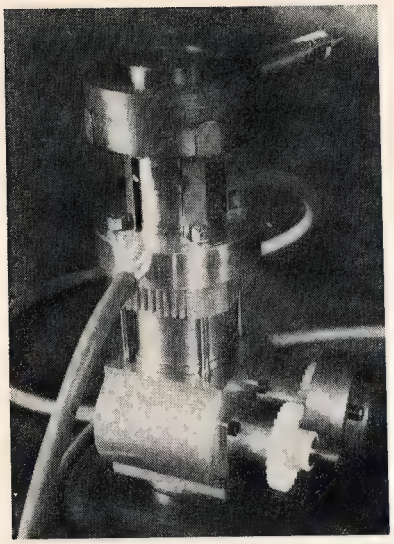
I also attached the hot cap to the displacer with epoxy. Some readers, with less enthusiasm for epoxy, will prefer to use a flange and conventional fasteners. By the way, if epoxy is used for any of these high temperature joints, be sure it can take the heat, rather than break down, evolving some sort of toxic fumes. If I seem overly cautious about fumes, it is because I know many of the operations we take for granted are in fact quite dangerous. I have no idea of whether epoxy offers any such danger, but that is precisely why I mention the possibility.

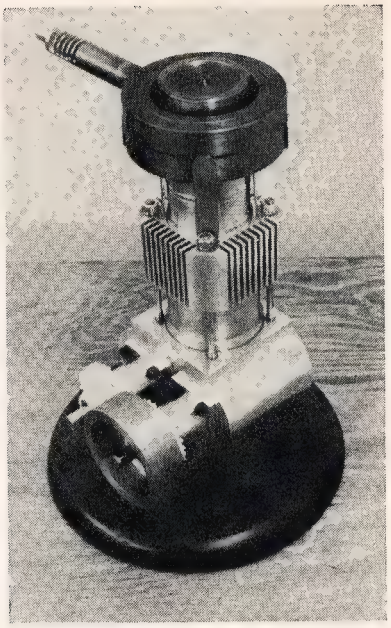
I used moulded Delrin gears, because they are quiet and need no lubricant. Unfortunately they have considerable backlash, and eventually I expect to machine better ones from Delrin. Of course, any sort of gears could be used.

I attached my flywheel to one gear by "alpha" cement, which has worked well so far, much to my surprise (I am surprised that anything can hold such a slippery substance as Delrin). The gears themselves are attached to the shafts by set screws, which have worked very well, but because the compression ratio is so high I would recommend



Right: A close-up of the annular propane burner.





Left and right: Two pictures of the completed Rhombic drive Stirling engine, with burner.

taper clamps to the careful builder, especially if pressurisation is contemplated.

To hold the wrist pins in place, I used commercial retaining rings. Those for the displacer yoke are the conventional type requiring a machined groove. Later I discovered the self-locking style ring, which is thicker and requires no groove: these were perfect, since I could now use hardened dowel pins for wrist pins. No retainer rings have been necessary on the crankpins.

At this point the engine can be assembled and tested under heat, with a torch. You will probably be very surprised how high the compression is. I even wondered if my little flywheel would suffice. However, once I supplied the heat, the engine turned over more easily, until finally it was hot enough to run. My hand tach indicated 800, 1100, 1500, 1900, 2100, and finally 2250 r.p.m. I was very pleased, and the only job remaining was construction of an annular propane burner.

K. The Burner

The burner uses propane and is capable of intense heat. Its capacity can readily be enlarged by adding additional jet holes on the inside of the annular ring. However, getting the burner "just right" is something of an art. The annular ring portion is easy enough, and it may be made with confidence. Before pressing the inside ring into the outside, be sure to wrap the inside ring with fine mesh (70 strands per inch will do) screen, suitable for the fairly high temperature. This prevents light back, and allows the gas-air mixture to reach a uniform pressure around the annulus before proceeding through the jets. Without the screen, all the mixture will go out of the jets nearest the mixing tube. The screen may be held in place with a strand of wire.

The mixer tube and orifice are the difficult parts. Together they control the mixture and the pressure. I used commercial brass orifices from a small and a medium size propane torch. At one point the small one was performing perfectly, but after I epoxied the orifice in place, it worked miserably; apparently enough extra gas was leaking around it to make a proper mixture. This was later confirmed by tests with a liquid sealant. Ultimately, I got good performance with the larger orifice, and it is now permanently fixed in the burner. Its orifice is .007 in. or slightly less.

In testing the burner, please be careful. If you turn the pressure too high, and if the orifice is too small, or if it is clogged, the rubber hose connector can blow off the pipe or split.

If the burner lights easily with a smooth soft blue flame that clings to the hot cap, and burns above it as well as around it, then you're not getting enough air, or the orifice is too large, or both. You want 100 per cent aeration, with adequate volume, and when you achieve it you will have a burner that acts funny when cold. The flame will revolve around the hot cap, or flicker, or burn intensely in one place and not at all (or *above* the cylinder) in another. This is probably all right! Keep the pressure low, and as the burner and hot cap warm up you will find (unless you have too much air or too small an orifice, or both) that the flame returns to the jets and becomes rock steady. You can now turn the pressure up a bit. The flames will be a bright intense blue, and they will burn in the gap between the burner and hot cap. They will also make a bit of noise as they

Continued on page 820

A 5 in. GAUGE "RAIL-MOTOR"

by Anthony T. Vince

MY OWN INTRODUCTION to model engineering was at the early age of seven, when in my father's workshop I constructed a stationary engine from odds and ends. As will be realised my father was a keen modeller and lost no time in indoctrinating me! I soon became fascinated by the world of steam and of model engineering.

Over the years I have become increasingly interested in steam locomotives, particularly from the point of view of running them. As my colleagues in High Wycombe will bear out, whilst I admire the "exhibition class" model, the engine that performs well has always held my attention and I obtain great satisfaction from sitting behind a locomotive in steam.

I therefore was most interested when Don Young published the design for the "Rail Motor" locomotive, which looked to be an engine well suited for size and running purposes. Particularly as High Wycombe Model Engineering Club do a lot of fete work with a portable track in order to raise funds for the new permanent track which is now under construction. Rail Motor looked to be a particularly conveniently sized locomotive for transporting to and at fetes. Also it was something different and looked attractive in a cheeky sort of way.

So I decided to build a 5 in. gauge Rail Motor, which readers may have seen at the 1975 Model Engineer Exhibition and the following notes outline the course of events which followed the receipt of drawings and castings.

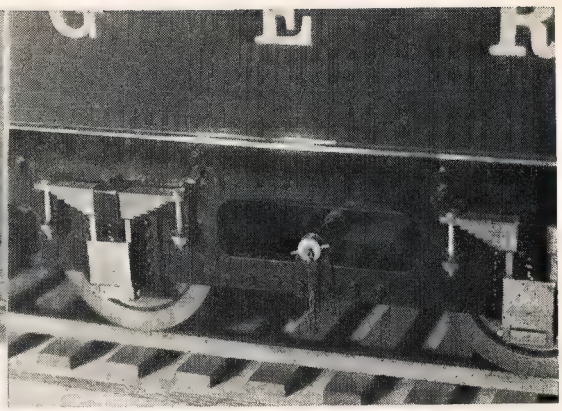
The design of the locomotive is basically very good, but there are some design errors which would prevent the assembly of the locomotive. For instance the tender being double framed has spacers between the two frames. The position shown on the drawing would necessitate cutting a portion out of the tender wheels in order to get the wheels in—this of course would stop them going round! There are other errors of this nature and I would be pleased to assist anyone completing a Rail Motor if they would like to contact me.

The castings were obtained from a well-known supplier and were a complete set with the exception of the dome which was not available at the time so a *Butch* dome was used. The boiler was professionally made in order to save time and is to drawing. The locomotive does not strictly follow the design of Rail Motor in all respects since we all have our own preferences as to internal plumbing and cab layout, etc.

Construction followed conventional sequences of cutting out the frames, etc. Cast gunmetal hornblocks were used with oilers fitted in the top of the hornblocks to enable oiling to be done from outside. Some of the frame spacers were omitted as I

The 5 in. gauge Rail-Motor does a spot of passenger hauling. The engine is finished in Great Eastern colours.

"Tom" has proved a useful passenger-hauler.



The tender has a handy drain plug.

thought them unnecessary in so short a locomotive.

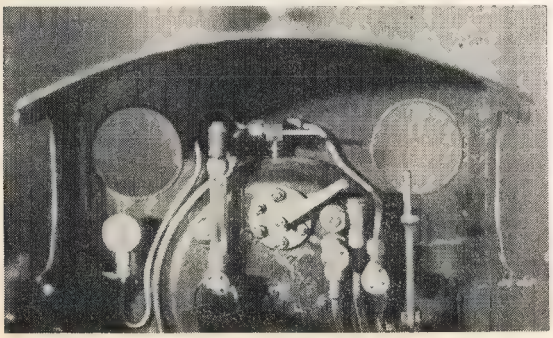
The axle-driven pump is per drawing but the eccentric strap is of hollow construction and is filled with trimming for self lubrication of the eccentric internally. The lubricator pump is also driven from this eccentric and has an overflow pipe from the lubricator tank which is located over the hollow eccentric strap.

Coupling and connecting rods are of a more conventional type in order to withstand the excessive loads anticipated and subsequently hauled. Most bearing surfaces were "beefed up" for the same reason.

The cylinders are as per drawing—$1\frac{1}{4}$ in. bore. One oil pump was fitted between the frames since I was not too happy about the capacity of the oil tanks in the design, as the locomotive would have to run for long periods with minimal attention. The valve gear was re-proportioned for personal preference. The crossheads and slide bars are again to my own design since I felt that the original ones were not really man enough for the amount of work intended.

The bunkers of the cab are filled with lead in order to bring the centre of gravity further back as the locomotive is otherwise inclined to bounce at the cab end because so much weight is forward of the leading axle. This additional weight, of course, has the added advantage of increasing the adhesive weight of the locomotive.

The controls are very accessible.

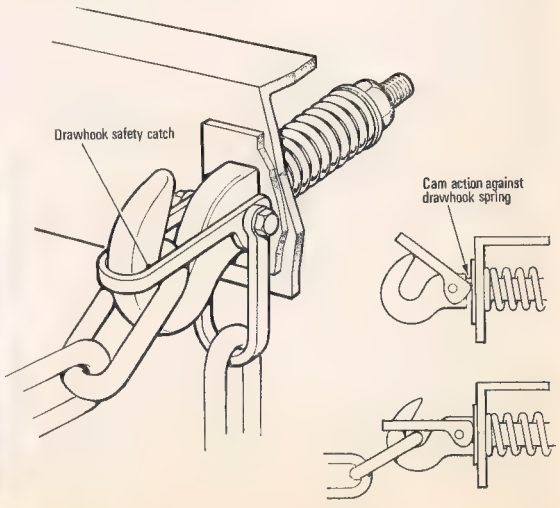


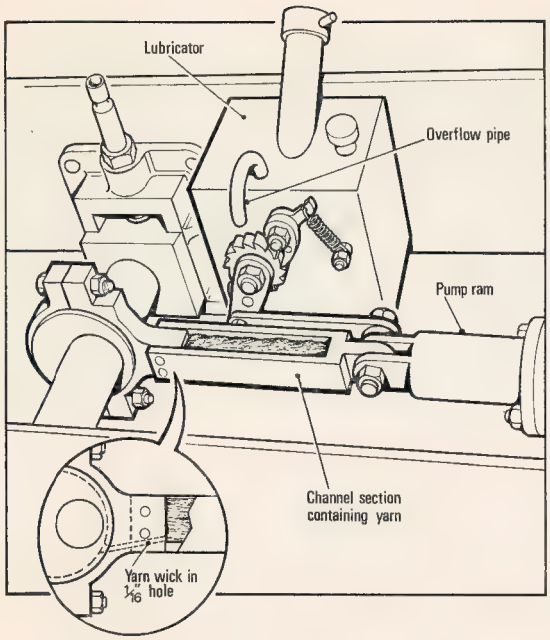
Locomotive brakes have been omitted as I feel much extraneous detail is too easily damaged on a locomotive intended for hard work. The only detail concessions made have been the Great Eastern code discs and the headlamp and the dummy whistle on the safety valve; also the scale firing shovel clamped to the inside of one cab bunker. This made the other cab bunker look a bit bare so a frying pan was made and clamped to the other side. (It just takes a sparrow's egg!)

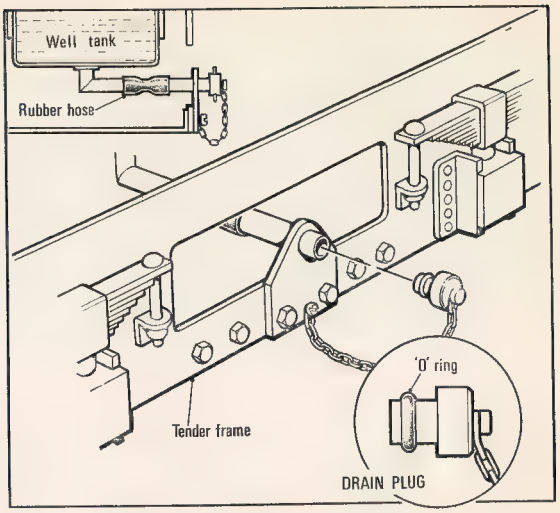
The paint used is a vehicle finishing cellulose paint—Gipgloss Orient Blue. Practically all of my locomotives seemed to be painted blue and it goes nicely with the polished brass and the occasional splash of red.

Having seen one locomotive "run away" from its proud owner after the coupling chain jumped the hook, I have fitted a very successful safety clip on the tender draw hook, of which the accompanying sketch is self explanatory. A drain pipe $\frac{3}{8}$ in. bore fitted with a dummy hose connection cap is fitted

A useful safety device.







The tender drain plug.

Left: The lubricator and pump drive is ingenious.

to the tender tank well and is very convenient when emptying down after a day's running since locomotive and tender are left more or less permanently connected. I am surprised that more locomotives are not fitted with such a drain. It is so much easier than mopping up water spilt in the car.

A water gauge glass protector was carved out of $\frac{1}{4}$ in. square brass tube and enhances an otherwise conventional water gauge. Blast pipe and nozzle and steam pipe arrangements within the smokebox are not as per drawing but are arranged according to my own preference. I feel that insufficient attention is paid to the design and location of blast pipes, etc., and a little experimentation in this area would improve beyond belief many locomotives running today.

It will be seen that design alterations made during construction were almost all with the same aim in mind—to produce an engine intended to really earn its keep by passenger hauling at local fetes. Work was started on the locomotive in mid 1973 and it was completed in March 1974; and it was commissioned straightaway when its test run was also a passenger hauling job at a fete in Maidenhead in April 1974. Fortunately it was quick drying paint!

The second run with the locomotive took place on the track at Blenheim Palace when a fellow member observed with great glee that the smokebox door was glowing a dull red after completion of several laps. The locomotive has completed two very arduous seasons' work at local fetes, hauling an average load of six passengers at a time, and it will pull away with 10 p.s.i. on the clock, one notch from mid gear with ease. Coal and water consumption are very low. The locomotive is frequently in steam for periods of five hours plus. The heaviest load hauled to date (due to shortage of passenger trucks) is just over one ton.

The most satisfactory working pressure has been found to be 60 p.s.i. Since it is quite possible for the locomotive to "lose her feet" at this pressure, higher pressure would just seem to be a waste of energy. To avoid the obvious comments about superheating, the superheater elements are so short that they simply act as dryers and I am sure therefore that high working pressures cannot give you the advantage of a high superheat.

I hope these notes and sketches will assist other readers undertaking the construction of a Rail Motor and perhaps even encourage others to think of building one.

Although Don Young's ears may have burned from time to time while I was constructing this locomotive, when the previously mentioned design errors were discovered, I would like to compliment him on a basically sound design which has given and I am sure will continue to give me the greatest satisfaction. I think the late lamented "Curly" would have loved this one.

AGAIN AVAILABLE:

"Model Steamer Building," A reprint of the original little book published by Percival Marshall. 50 pp. Price £1.50.

A Stephenson long-boiler locomotive

by Jack Davies

IT IS UNUSUAL to see an illustration of a model boiler undergoing its initial "double pressure" hydraulic test. I therefore submit this picture of my latest boiler being subjected to the test. This test of course is purely for my own satisfaction and in due course, when the locomotive is completed, the whole will be subjected to test under club rules in the normal manner and a certificate obtained.

The label attached to the pressure gauge is recording the test pressures at various readings by laboratory test.

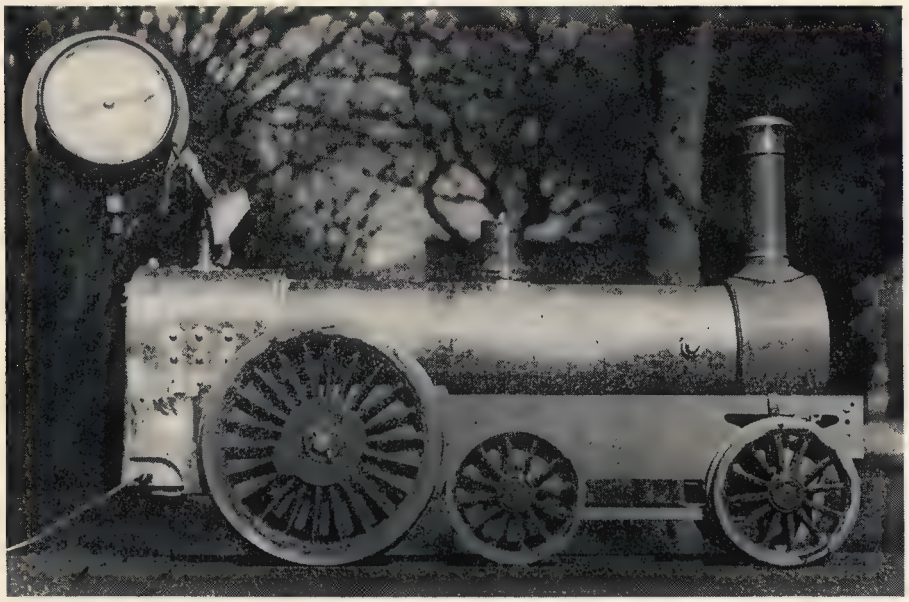
My boiler is fully brazed including the stays and although it is not quite like the present-day type it does contain up-to-date features that will enable it to perform its duty, I hope, to steam two cylinders of $1\frac{1}{4}$ in. bore x $2\frac{1}{8}$ in. stroke, the driving wheels being 7.2 in. dia.

The following are details of its construction:

Barrel diameter	$3\frac{7}{8}$ in.	16 gauge copper
Barrel length	$14\frac{1}{2}$ in.	
Length of outer wrapper	$4\frac{1}{2}$ in.	16 gauge copper
Width of outer wrapper	$3\frac{7}{8}$ in.	
Length of firebox	4 in.	
Width of firebox	3 in.	
Combustion chamber (length)	4 in.	
Cross water struts (4)	$\frac{3}{4}$ in. dia.	16 gauge copper
Superheater flues (2)	$\frac{3}{4}$ in. dia.	20 gauge copper
Fire tubes (13)	$\frac{3}{8}$ in. dia.	20 gauge copper
Length of tubes	$10\frac{1}{2}$ in.	

It will be seen that the firebar area is about 12 sq. in. but in a very deep firebox and no doubt I will have to learn its requirements when on the track.

The barrel diameter at the figure quoted is to allow for lagging for which I use $\frac{1}{6}$ in. thick cork; the cladding will be of brass .015 in. thick.



The boiler of the Stephenson long-boiler engine under hydraulic test.

The model is based on the "A" type 2-2-0 LNWR Southern Division.

DRILL GRINDING JIG

SIR,—I am making a drill grinding jig to the Duplex design described in *M.E.* in 1963-4, and I would like to contact any reader who has made one of these jigs. The description started in Vol. 129 p. 500 and continued into Vol. 130.

The jig I am making will fit onto the Quorn grinder, but I am not happy with the point shape which results from the geometry given by Duplex, derived from an article originally published in 1913. It is possible that I have overlooked something in adapting the design to the Quorn such that the geometry has altered. The main problem is that the clearance angle increases very rapidly behind the cutting edge when compared with a new drill. For this reason I would be pleased to contact anyone who has either made a jig in the form described by Duplex or who has more knowledge of drill point geometry.

Should I arrive at a satisfactory solution, I would endeavour to describe the results for the benefit of other readers.

22 Hatfields, Loughton, Essex. I. Strugnell

MODEL ENGINEER HOT AIR ENGINE COMPETITION

A COMPETITION to encourage the design and building of hot air engines will be held at the 1977 Model Engineer Exhibition. Prizes have been generously donated by Mr. A. N. Clark, of Ryde, Isle of Wight, and Professor D. H. Chaddock, C.B.E., has kindly consented to act as Judge.

The only conditions are as follows:

1. The hot air engine entered must be the unaided work of the competitor.
2. No entry will be accepted from a professional model maker.
3. The decision of the Judge/s shall be final.
4. The swept volume of the working cylinder/s shall not exceed 5 c.c.
5. The power output of the engine will be measured by a friction brake with a lever arm and weights.
6. Speed measurement will be by revolution counter and stop watch.
7. All engines entered must have a standard output shaft 5/32 in. dia. x $\frac{3}{4}$ in. (approx.) long.
8. Competitors will have the option to run their engines themselves, under the scrutiny of the Judge/s.
9. Competitors should submit with their entry notes for the Judge/s regarding lubrication, firing, warm-up procedure, minimum and maximum revs. at which the engine should be run.
10. The duration of each run shall be left to the discretion of the Judge/s.
11. Winners will be required to submit details, a photograph and drawings of their engines for publication in *M.E.*
12. Although every care will be taken, the organisers cannot be held responsible for any accidental damage to the engines.
13. Details of entries must be sent to the Exhibition Manager, M.A.P. Ltd., not later than 1 December 1976.

PRIZES:

1. A first prize of £50 would be awarded for the hot air engine developing the highest horsepower.
2. A second prize of £25 would be awarded for the engine developing the second highest horsepower.
3. There would be a consolation prize of £10 for the engine (other than those awarded the 1st and 2nd prizes), which displayed the highest standard of workmanship.
4. There would be a second consolation prize of £10 for the engine which displayed the most original design work.

C/I Piston Rings for Miniature Steam Engines

SIR,—My interest in a model condensing marine plant has led to the construction of an experimental engine 0.4 in. x 0.4 in. intended to run without internal oil and rely solely on traces of condensate for lubrication. This requires internal bearing loads to be kept to the minimum necessary to provide adequate seals and has been attempted by fitting a balanced valve and "low pressure" rings. These rings, 0.4 in. x 0.15 in. x 0.15 in., were made by a slight modification of Prof. Chaddock's method which might interest readers.

After chucking, the centrifugally cast iron rod was first drilled 1/32 in. below finished internal diameter and the outside turned to exact finished size. The parting tool was now used to produce grooves exactly 0.015 in. deep and spaced to leave the width of the rings a few thou. oversize. Finally the hole was carefully bored to finished internal diameter, resulting in a neat cluster of rings on the neck of the boring tool. Ring sides were lapped to within 0.0005 in. of finished size before breaking by laying the ring on a hard flat surface with a 1/16 in. drill shank under one side and applying gentle thumb pressure.

In an article on piston rings by Michael Smart (*Model Engineer*, August 1974) it was explained that optimum performance requires the steam to shift the ring across its groove and seal it against the far land before pressure builds up sufficiently under the ring to seal it against the cylinder wall. This requires the relaxed ring to provide initial cylinder seal only whilst moving very easily across a groove of minimum width to seal against a highly finished land.

"Out-spring" was therefore reduced to that given by a wedge T x 2 (0.030 in.) and, before cooling, the assembly was luted with a ring of soft copper wire. After cooling it was found that removal of the wedge reduced the gap to approximately 1.5T and that the copper seal had prevented any scale forming on the outside of the ring—it was still soft grey iron.

However the rings would not re-enter the bore until the gaps had been lightly dressed with a file. Could this be due to minute bruises on the raw edges caused by inserting the wedge?

The gap of only 1.5 x T had resulted in rings which could not be sprung over a solid piston and this was solved by building up a piston consisting of a stainless steel core carrying five cast iron "washers" (three lands and two spacers). By lapping the faces of these washers sealing surface finish and ring clearance could both be closely controlled.

The finished piston slides very easily, making 6000 r.p.m. at less than 20 p.s.i., and after several hours of "dry" running the rings have bedded down perfectly. Incidentally, between runs the engine is protected by filling with Ensis fluid.

Whilst making the above rings I also made a set of four for a piston valve 0.25 in. x 0.01 in. x 0.01 in. (success rate 80 per cent). In the event these were not used and frequent demonstrations of their surprising strength to interested parties have now reduced the number to one!

Elstead. F. M. Collins

MARSHALL PORTABLE STEAM ENGINE

A new project by W. J. Hughes, who describes how to build a $1\frac{1}{2}$ in scale version

Part II

From page 705

THE FIRST STEP in building the portable engine will be to part-build the boiler, of which the arrangement is given on the next two pages. I say "part-build", meaning substantially the outer shell, but without the smokebox tube-plate and the boiler front (which is what a locomotive man calls the backhead), and of course without the inner firebox. The boiler front actually will be made, but secured in place for the time being by a few nuts and bolts so as just to support the wrapper.

This procedure will give us the chassis, so to speak, of the machine, on which to mount and line-up the cylinders and motion and any other convenient parts, yet giving us access to the interior for riveting or other operations.

The boiler is designed with ample strength for working at 100 p.s.i. (70.3 kg./cm.^{2}), but is scarcely likely to be required to run at that pressure. I recommend setting one safety valve at 50 p.s.i. and the other at 60 (42.2 kg./cm.^{2}), but I think it will be found that where it is just desired to have the motion ticking over — say at an exhibition for demonstration purposes — about 20 p.s.i. will be ample. There's little sense in using fuel and water simply to blow steam away!

Construction of the boiler is on conventional and well-accepted lines, with plate girders to support the firebox roof but not connected to the outer wrapper. It is interesting to note in passing that Marshalls themselves simply pressed the crown plate into a cruciform corrugated pattern, with the corrugations springing from opposite corners of the box and crossing diagonally in the middle. No other crownstays were used.

This formed a very strong truss to the crown which could "breathe" happily and was easily cleaned, but consideration showed that corrugation was not a practical proposition for our purpose. No longitudinal stays are fitted to the model, and the upper parts of the boiler front and the smokebox tubeplate are supported by bars on the inside. Please note, by the way, that to the portable "tender" the boiler front actually *was* the front of the boiler, where he stood when stoking and tending the engine.

There is no need for a hollow stay to supply steam to the blower, which is fed from the turret of the front safety-valve. I have shown the boiler tubes inclined up to the front, which does have certain advantages, but can be a matter of personal choice to the builder—after all there are large numbers of engines running with parallel ones.

The screwed stays are normal except for three at each side which are hollow. This is to allow a short piece of angle to be riveted on, by which the hind axle is secured.

Talking of stays raises the question of screw threads in metrication, since it is only a matter of time before our familiar BA, ME 40-thread, and other old favourites either disappear, or become so expensive by being "specials" that it will be uneconomic to replace broken or worn-out tools in those threads. How long this will take is anyone's guess, but it is no use trying to ignore it.

So, facing the facts, on my drawings I am putting alternative metric threads *as well as* the old familiars. For example, 5 BA will become M3 x 0.5, and $\frac{1}{4}$ in. x 40 becomes M6 x 0.75. (The "M3" means that the nominal diameter is 3 mm., and the "0.5" is the pitch of the screw in mm.) Obviously it is not possible to obtain an exact match, but I am using the nearest available from the tables published by the British Standards Institution, of the ISO METRIC screw threads.

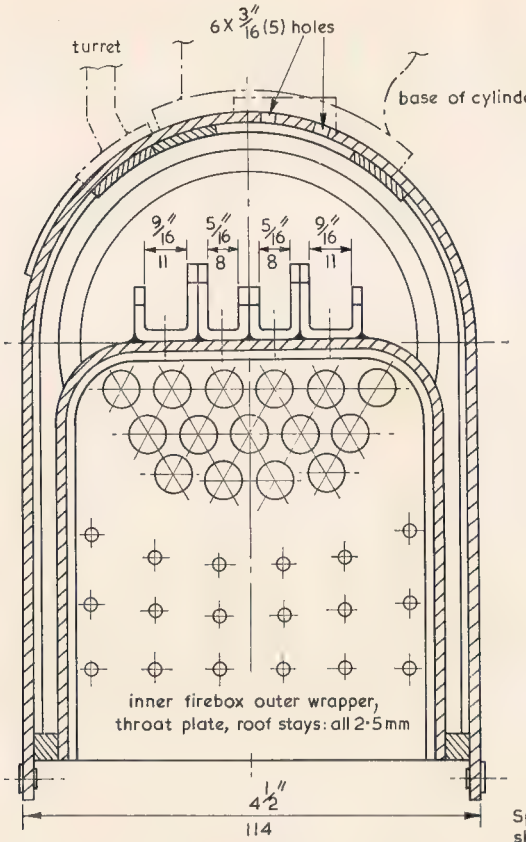
However, to save constant repetition in the articles, it is proposed only to quote the British standards in these, and anyone in doubt who needs the metric equivalent can look at the drawing.

Boiler: First Stage

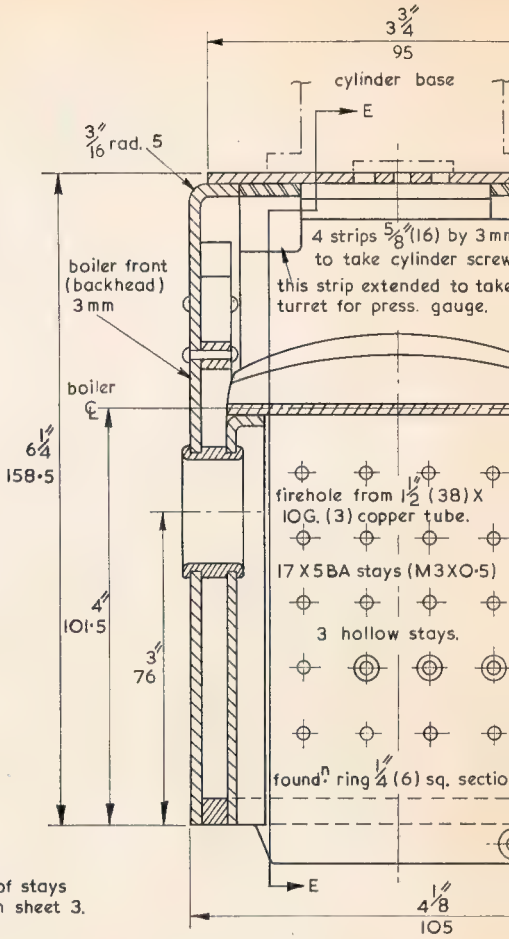
Reeves are supplying ready-flanged plates for the boiler front, throatplate, smokebox tubeplate, and firebox end-plates, but some individuals will prefer to flange their own in the time honoured way. A point to bear in mind is that on a portable the flange was always well rounded off, and the 3/16 in. shown on the drawing is not too much.

It is not necessary to describe construction of this boiler in full detail, I think, especially since it is not so very long ago that Don Young did so with his "Derby 4F" (of which the barrel was the same diameter and thickness). We will just run through the main steps and outline the differences as we go along.

After squaring the ends of the barrel, file a

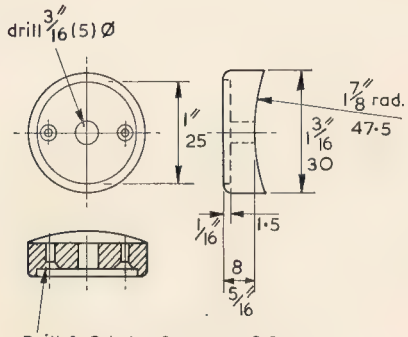


Section E-E


3 3/4 95
cylinder base
E
3/16 rad. 5
4 strips 5/8 (16) by 3mm to take cylinder screw
this strip extended to take turret for press. gauge.
boiler front (backhead) 3mm
boiler ℄
6 1/4 158·5
firehole from 1 1/2 (38) X 10G. (3) copper tube.
17 X 5BA stays (M3X0·5)
3 hollow stays.
4 101·5
3 76
found.n ring 1/4 (6) sq. sectio
E
4 1/8 105

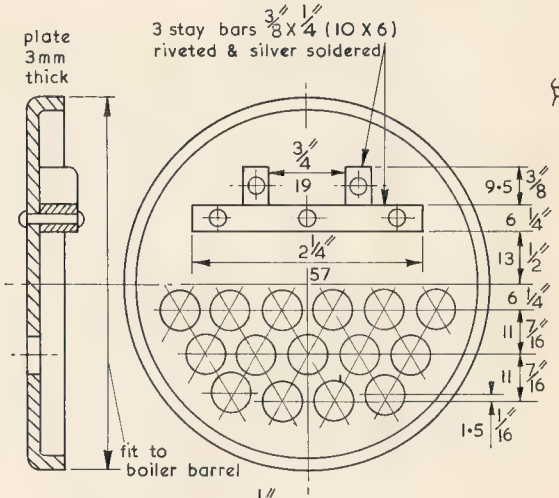
Spacing of stays shown on sheet 3.

All bushes & stays are of gunmetal: all other boiler components copper, unless stated otherwise.



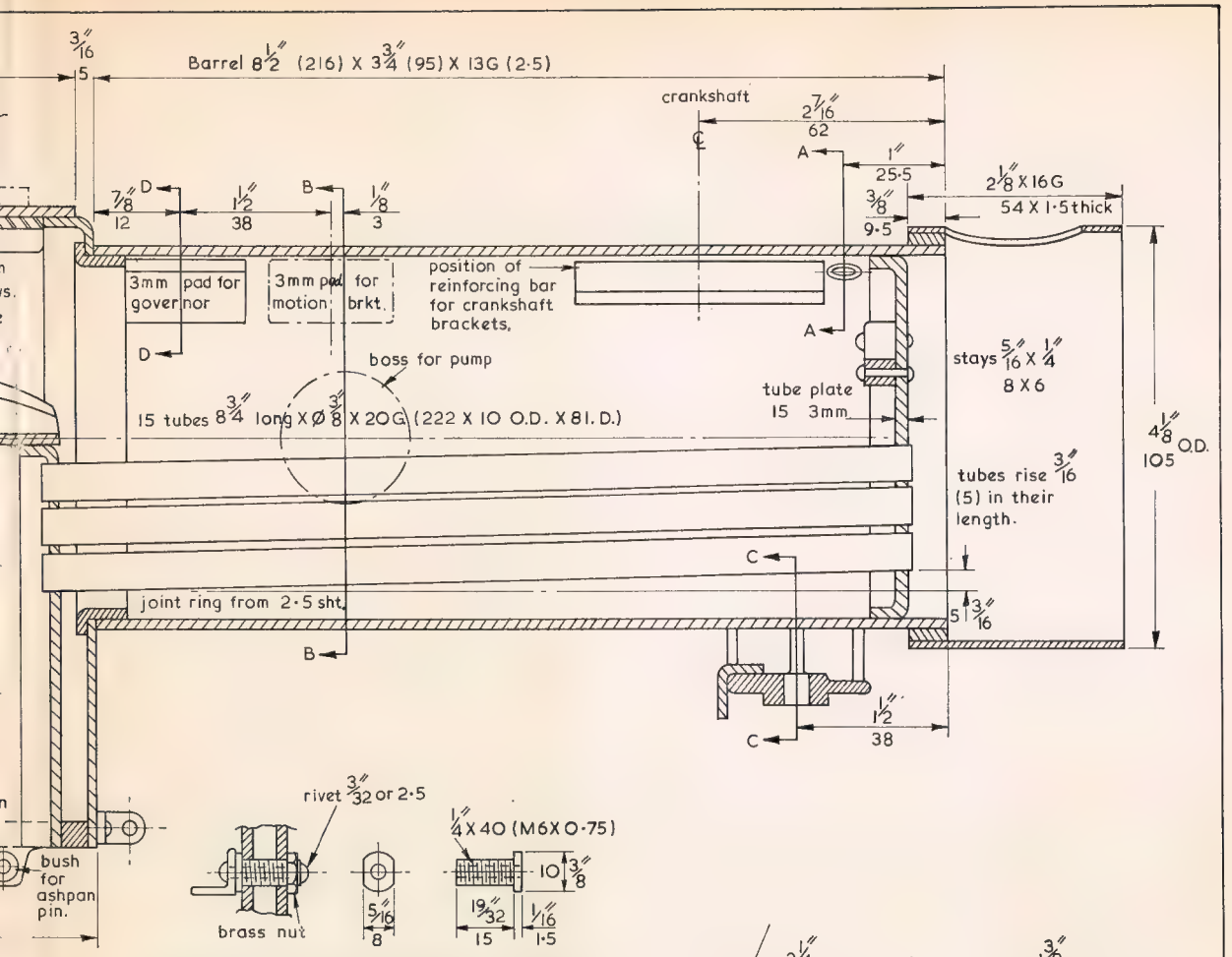
Drill & Csk. for 2 screws 8 BA (M2 X 0·4) to hold pad in place whilst sil. soldering to barrel.

PAD FOR WATER PUMP 1 off

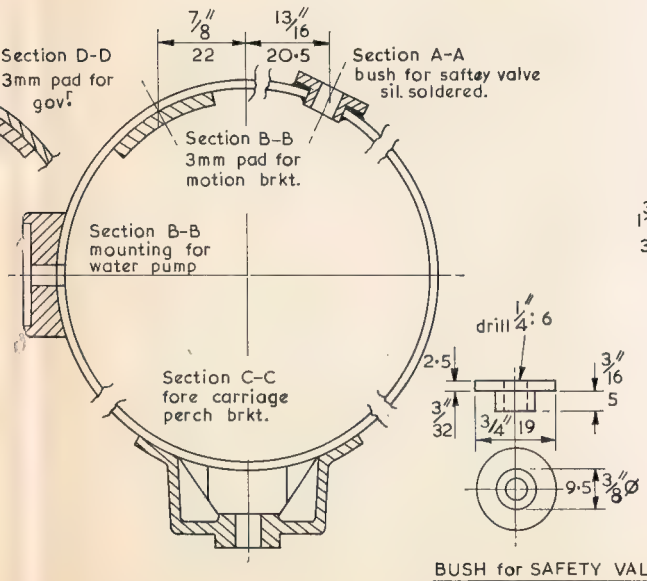


tubes all at 1/2 (12·5) hor. crs.

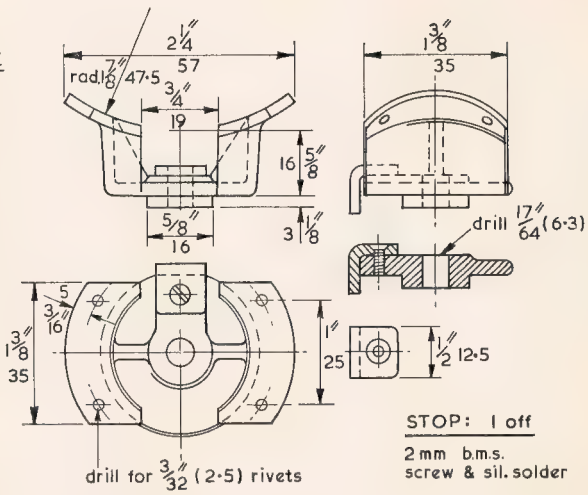
LAYOUT OF SMOKEBOX TUBE PLATE



HOLLOW STAYS FOR MOUNTING HIND AXLE ANGLES 6 off



BUSH for SAFETY VALVE



PERCH BRACKET:
rivet & sil. solder to boiler

STOP: 1 off
2 mm b.m.s.
screw & sil. solder

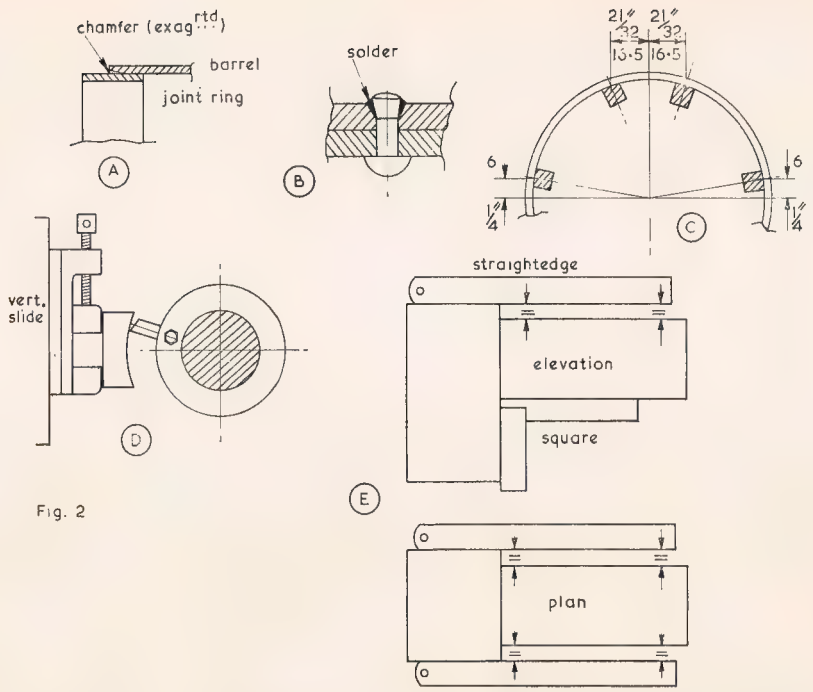


Fig. 2

slight internal chamfer at the throatplate end, as sketched in Fig. 2A. This is a tip from Alec Farmer, who has found it encourages the silver solder to flow into the joint-ring, which can now be fitted, with a few rivets to hold it in place.

Another tip from Alec here is not to rivet the heads over tight, which will distort the copper. Instead, leave a slight gap round the countersink (Fig. 2B), which again leads in the solder. When trimmed off with a file there should be a bright ring of solder showing round the rivet. And of course this tip applies in other places where rivets are used for temporary assembly whilst soldering.

Check the throatplate for flatness, file its flange parallel, and clamp it to the faceplate, flat side outwards. Trepan out the circle for the joint ring to fit. File off any surplus from the flange of the boiler front.

The Outer Wrapper

Since the curved flange or saddle of the base of the cylinder has to make a steam-tight joint with the outer wrapper of the firebox, it follows that the wrapper should be bent to as accurate a curve as possible. This can best be done, probably, with a set of rolls, and it may well be worthwhile to make some if they are not available—drawings are available from the M.A.P. office for a simple set.

On the other hand, since the sheet will become well annealed whilst soldering on the reinforcing pads, and in the later closing up of the boiler, it may well be that any slight irregularities will be "pulled out" by the fixing screws of the cylinder saddle. (This was another consideration in deciding not to use plate stays between inner and outer wrappers.)

Use a few temporary screws and nuts to secure the wrapper to the flanged plates, placing the holes for these 3/16 in. (5) from the edges where the rows of dummy rivets are to come later, and making sure that all is square. Prepare the four $\frac{5}{8}$ in. (16) wide strips of 3 mm. plate for the reinforcement of the crown, and secure each with two or three rivets. Note that the strip nearest the firebox front is extended downwards to take the base of the turret for the whistle and pressure gauge. At this stage too the dummy manhole and its central boss may be fitted.

Reinforcing the Barrel

Two 3 mm. thick pads are required for the boiler barrel, one $1\frac{1}{4}$ in. by 1 in. (31.5 by 25) for the motion bracket placed as at Section B-B, and one $1\frac{1}{4}$ in. square for the governor stand, placed as at Section D-D. The bush for the forward safety valve is turned from $\frac{3}{4}$ in. (19) diameter gunmetal or bronze rod, and inserted as at Section A-A.

For the brackets for the crankshaft bearings, four longitudinal pieces of 5/16 in. (8) square section bar are required. They are $2\frac{1}{2}$ in. (64) long, and placed as on Fig. 2C and the boiler side elevation. They can be fixed with a couple of rivets each, or with gunmetal screws.

The pad to which the water pump will be fixed is a gunmetal casting with a chucking spigot cast on the outer face. Take a skim off the spigot and then grip it in the 3-jaw chuck, and turn the body to 1 3/16 in. (30) diameter. Set a scribing block to centre height, and with the "hollow" of the casting horizontal scribe a centre line on that side and down the edges.

Grip the spigot in a machine vice on the vertical-slide (Fig. 2D) with the line at centre-height and use a fly-cutter at $1\frac{7}{8}$ in. radius (47.5) to machine the hollow to be a good fit to the boiler barrel. Remount the pad in the chuck, with the spigot outwards, and turn this away, making the recess and drilling the central hole at the same setting.

Drill the holes for the countersunk screws, and secure the pad to the barrel with two screws made from gunmetal or bronze, after covering all its surface with Easyflo paint. The purpose of this is to seal any porosity in the casting which, being under pressure, could possibly leak.

The perch bracket also is a gunmetal casting, with a chucking spigot beneath. Grip the casting in a 4-jaw chuck, running true, and take a skim off the spigot, set this is the 3-jaw and face the flat surface inside, between the strengthening ribs.

Grip the spigot in a machine vice on the vertical-slide, and as with the pump-pad flycut the flange to fit to the boiler radius. Reset the casting in the 4-jaw chuck with the spigot running true, and machine off the surplus leaving the $\frac{5}{8}$ in. by $\frac{1}{8}$ in. boss (16 by 3) on the faced-up bottom. Centre and drill the hole 17/64 in. (6.3) for the pin.

Here later the boss will mate with a recess turned in the turntable of the fore-carriage fork which holds the front axle. The small stop shown, bent up from mild steel, works in with a lug cast on each side of the turntable to prevent the front axle from being over-locked which might make the whole machine unstable. The stop is secured by a small countersunk screw and a touch of silver solder paint, after which the bracket may be riveted (lightly again) in place (Section C-C).

Silver Soldering

I am assuming in all this that every mating surface to be soldered has been cleaned before assembly, and kept clean during it of course. Apply flux to every joint, not forgetting the heads of any rivets and/or screws, and also any inside bits not normally visible. Stand the shell on its smokebox end, have the B6 alloy handy, and get the torch going.

Heat up the upper end of the barrel and apply the B6 all round the ring joint as soon as it will run freely. Gravity and capillary attraction will both help it to run down into the joint, but it cannot flow if the whole joint isn't hot. When satisfied that it has penetrated through, move the flame lower to concentrate in turn on the pads for the governor stand, motion bracket, and water pump. For the first two, apply the flame outside but the stick of B6 inside. For the pump-pad, touch the ends of the screws inside but then run a good fillet around outside.

Now stand the boiler on the joint ring, heat up the smokebox end, and solder the crankshaft bracket pads and the perch bracket, the pads with a good fillet inside and the bracket outside.

Allow the shell to cool off somewhat, and then lower it gingerly into your pickle. Wash off in running water, and inspect all joints for thorough penetration. Re-do any doubtful ones before carrying on.

If any surplus solder lies in the angle made by the joint ring and the barrel, file it out until the throatplate can sit properly in place, but tightly. Fix the throatplate, wrapper and boiler front together with your temporary screws and nuts, and put the plate in position on the joint ring, making sure that it *is* properly in place and pushed right up to the shoulder.

Now use a straight edge along the top and sides (Fig. 2E) to check that the wrapper lines up parallel with the barrel, and a square on the throatplate. If all is well, remove the wrapper and boiler front, put the throatplate back on the joint ring, and hammer down the flange of the ring to secure it—not hard enough to distort the metal, but sufficient to leave no gaps.

Replace the wrapper, and substitute 3/32 in. (2.5) rivets for the temporary screws. The rivets should be countersunk lightly outside so that they can be filed off flush later with little trouble. For the tyro it may be explained that the strength of the joint lies in the soldering, with little or none added by the rivets. Check once again to see that the wrapper and barrel still line up parallel. Apply flux around both and also around the strengthening pads inside the crown of the wrapper. Again stand the barrel upright, on the smokebox end.

As always, apply the heat fairly gently at first, so that steam generated from the water in the flux will not "explode" and form blowholes in the flux before it can melt.

Concentrate on the joint ring at first, heating mostly from the outside, and run in a good fillet of B6 alloy around it. Switch to the joint between throatplate and wrapper, and again make a good fillet on the inside. If the heat is kept to the outside, the solder will run through the joint, but it should show only as a line on the outside and not a fillet, which would have to be filed off.

Lastly, play the torch on the crown of the wrapper, and secure the reinforcing strips and the dummy manhole. Allow to cool somewhat, pickle and check all joints after washing and scrubbing.

CLUB DIARY

Dates should be sent at least five weeks before the event to ensure publication. Please state venue and time. While every care is taken, we cannot accept responsibility for error.

AUGUST

20 Romford M.E.C. Track and Barbeque. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch, Essex. 8 p.m.
20 East Sussex Model Engineers. Pond Night—Boating Lake, Alexandra Park, Hastings. 7.30 p.m.
20 Stockport & District S.M.E. Bits and Pieces. Wellington House, 324 Wellington Road North, Stockport. 8 p.m.
20 Rochdale S.M.E.E. General Meeting. Springfield. 8 p.m.
21 Wigan & District M.E.S. Meeting. Co-operative Guild Room, Thompson Street, Whelley. 7.15 p.m.
21 Harrow & Wembley S.M.E. Exhibition. Greenford Hall, Greenford Broadway. 9 a.m.
21 Chesterfield & District M.E.S. "Ladies Day" at the Track, Hady, from 2 p.m
21/22 Perranporth & District M.E.S. Annual Exhibition at West of England Steam Engine Society's 21st Rally. Silverwell Farm, Nr. St. Agnes, Cornwall.
21/22 National Traction Engine Club. World's Greatest Steam Fair, Windsor Forest, Berks.
21/22 National Traction Engine Club. West of England Steam Engine Society Rally. Silverwell Farm, Silverwell, Nr. St. Agnes, Cornwall.
21/22 National Traction Engine Club. Leicester Diocesan Jubilee and Market Bosworth Steam Engine Rally. Cadeby, Market Bosworth.
21/22 National Traction Engine Club. Fairford Traction Engine Rally and Show. Fairford Park.
22 King's Lynn & District S.M.E. Track Day—Neighbouring Clubs and Visitors welcome. 10 a.m. onwards.
22 Kinver & West Midlands S.M.E. Kinver visit Wirrall Society.
22 Guildford M.E.S. Visit by Sutton M.E.S. HQ. Stoke Park.
22 Cannock Chase M.E.S. Steam Up. Cannock Park. 2 p.m.
22 Chelmsford S.M.E. Public Running. Waterhouse Lane. 2.30 p.m.
22 Malden & District S.M.E. Proposed Club Outing.
22 Harlington Locomotive Society. Public Open Day. High Street, Harlington, Middx.
23 Willesden & West London S.M.E. Track Night. Roundwood Park. N.W.10.
23 Bedford M.E.S. Steam Up Informal Meeting. Clubhouse, Wilstead. 7.30 p.m.
24 Sutton Coldfield & North Birmingham M.E.S. Model engineering quiz.
25 Sutton Coldfield Railway Society. N Layout and Chit Chat. Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.
25 Cannock Chase M.E.S. Cannock Park. 7.30 p.m.
25 Harrow & Wembley S.M.E. Track Meeting. Track side, Headstone Lane.
26 Hull S.M.E. Talk on the Holtzapffel Lathe by Guy Wilson. Trades & Labour Club, Room 3, Beverley Road. 7.45 p.m.
27 Torbay M.E.S. Meeting. Foxhole Community Centre, Paignton. 8 p.m.
27 Dublin S.M.E.E. General Meeting. City Quay Schools, Dublin 2. 8 p.m.
28 Cambridge & District M.E.S. Public track day. Fulbrooke Road, Cambridge. 3 p.m.
28 North London S.M.E. Late Evening Run —Colney Heath.
28 National Traction Engine Club. Rally—Egham & Thorpe Royal Agricultural and Horticultural Association, Runnymede, Egham, Surrey.
28/29 National Traction Engine Club. Rally Chapelton Barton, Umberleigh, Nr Barnstaple.
28/29/30 National Traction Engine Club. Leeds and District Traction Engine Rally.
28/29/30 Crofton Beam Engines. Open to the Public. Nr. Great Bedwyn, Wilts.
28/29/30 Northampton S.M.E. Exhibition in association with the West Midland Federation of the Model Making Societies at the Town and Country Festival to be held at the Royal Agricultural Show Ground, Stoneleigh, Warwicks.
28/29/30 National Traction Engine Club. Town and Country Festival. Royal Showground, Stoneleigh, Kenilworth.
28/29/30 National Traction Engine Club. Expo Steam '76. East of England Showground, Peterborough.
28/29/30 National Traction Engine Club. Late Summer Steam Rally. Church Farm, Tottenhoe, Nr Dunstable, Beds.
28 & 30 Brighton & Hove Society. Trackdays. Hove Park.
28/29/30 Guildford M.E.S. Steam "meet" at Siegen, West Germany.
28/29/30 Peterborough S.M.E.E. Public running on portable track at "Expo Steam". East of England Showground
28/29/30 Whitchurch (Cardiff) & District M.E.S. Open Days to the Public. Highfield Road, Heath, Cardiff.
29 Guildford M.E.S. Public Open Afternoon. HQ Stoke Park. 2–6 p.m.
29 Chelmsford S.M.E. Public Running. Waterhouse Lane. 2.30 p.m.
29/30 Bristol S.M.E.E. Public passenger carrying days. Ashton Court Track, Bristol.
29/30 Swansea S.M.E. Open Weekend. Public running, exhibition, refreshments from midday until 7 p.m.
29/30 Harrow & Wembley S.M.E. Harrow Show.
29/30 National Traction Engine Club. Leicestershire Steam Show & Transport Rally. Quorn and Woodhouse Station, Leics.
29/30 National Traction Engine Club. Rally—Bishop's Castle, County of Salop Society.
30 Welling & District M.E.S. Track Run. Erith Show & Sports, Recreation Ground, Erith.
30 Bracknell Railway Society. Public Running Day. Jocks Lane, Bracknell. 3 p.m. to 6 p.m.
30 Malden & District S.M.E. Public Open Day.
30 National Traction Engine Club. Horsham Lions Vintage Transport Rally. Horsham, Sussex.
31 Chelmsford S.M.E. Club Meeting. Natter over a pint, Maltsters Arms, Willingale.

SEPTEMBER

1 Harrow & Wembley S.M.E. Committee Meeting. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.
1 Bradford M.E.S. Illustrated talk by Bill Wood on the building of the M62 and M606.
1 Harrow & Wembley S.M.E. Committee Meeting. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.
1 Sutton Coldfield Railway Society. Damfsloks and Derbyshire by Ivan Davies (slides), Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.
2 Leyland, Preston & District S.M.E. Meeting. Roebuck Hotel, Leyland Cross, Leyland, Lancs. 8 p.m.
3 East Sussex Model Engineers. "London, Brighton & South Coast Railway" a talk by A. C. Perryman. Mercatoria Hall, Mercatoria, St. Leonards-on-Sea, E. Sussex. 7.45 p.m.
3 Stockport & District S.M.E. Members' and Wives' Track Social Evening.
3 Romford M.E.C. Competition Night. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch, Essex. 8 p.m.
3 Winchester M.E.S. Slide Quiz—members slides. 36 Bramshaw Close, Harestock.
3 Rochdale S.M.E.E. General Meeting. Springfield. 8 p.m.
4 Peterborough S.M.E.E. Public Running at club track, Lincoln Road, Werrington, Peterborough.
4 Northolt M.R.C. Exhibition. Community Centre, The Manor House, Northolt Village. from 1.30 p.m. to 6 p.m.
4 Northern Ireland M.E.S. Trackside Meeting. Transport Museum, Cultra.
4 Ickenham & District S.M.E. Public Running. Rear of Coach and Horses, Ickenham. 2 to 6 p.m.
4/5 Tyneside S.M.E.E. Open Days. Exhibition Park Track, Newcastle-upon-Tyne. All night running—All welcome.
4/5 Cannock Chase M.E.S. Exhibition at Forum Theatre, Cannock.
4/5 National Traction Engine Club. Hinckley Steam Display. Hinckley, Leicester.
4/5 National Traction Engine Club. Brill Steam Rally.
4/5 National Traction Engine Club. Selwood Vintage Farm Work, Beckington, Frome, Somerset.
4/5 National Traction Engine Club. Worthing Group Autumn Rally.
4/5 Guildford M.E.S. Track event at Guildford Town Show.
4/5 National Traction Engine Club. Stonehouse Model and Engine Show '76. Oldends Lane, Stonehouse, Glos.
4/5 National Traction Engine Club. Cornish Traction Engine Preservation Club, Wheal Honey, Liskeard, Cornwall.
4/5 Fylde Tramway Society. Transport Models' Exhibition. Lecture Hall, Queen Street, Blackpool.
5 Bristol S.M.E.E. Open Day—Visitors welcome. Ashton Court Track, Bristol.
5 Sutton Coldfield & North Birmingham M.E.S. Sunday Open Day at Lea Marston.
5 Guildford M.E.S. Running day for members and friends.
5 Hull S.M.E. Open Day at the Goddard Avenue Track. Commence 1 p.m.
5 Norwich & District S.M.E. Public Running. Eaton Park Track.
5 Chelmsford S.M.E. Public Running. Waterhouse Lane. 2.30 p.m.

MODEL PETROL ENGINE DRAWINGS

PE.7 Atom V, 30 cc. air-cooled two-stroke 45p

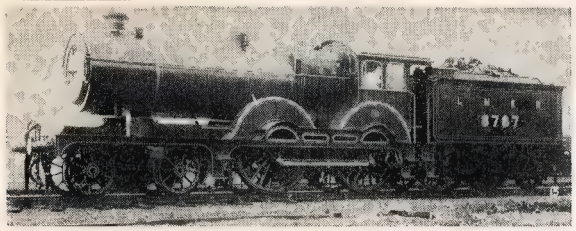
PE.16 Kiwi Mk. II, 15 cc. air or water-cooled o.h.c. four-stroke £1.45

PE.20 Seal, 15 cc. four-cylinder water-cooled side valve 90p

PE.27 Dolphin, 10 cc. o.h.v. air-cooled four-stroke 75p

PE.29 Sealion, 30 cc. four-cylinder o.h.v. £1.70

PE.30 Atomag Minor Mark IX. A miniature magneto for all small petrol engines 40p



SUPER-CLAUD

A new locomotive for 5 in. gauge, based on the large 4-4-0's of the old Great Eastern Railway

Part V

by Martin Evans

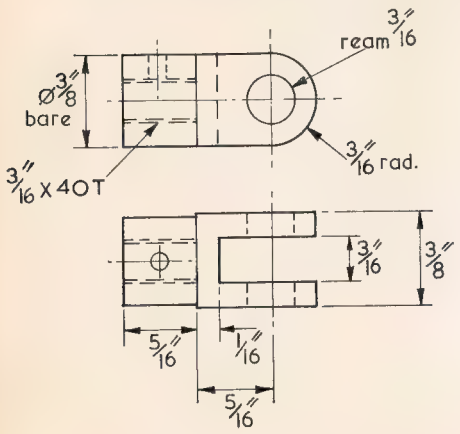
From page 653

GREAT EASTERN locomotives nearly always used single slide bars, and the Super-Clauds were no exception. For our 5 in. gauge model, they can be made of a section 7/16 in. x ¼ in., and the only work required on them is to cut the little recess seen at the rear end. Builders have a fairly wide choice of materials here. Ordinary bright mild steel could be used, which in combination with the phosphor-bronze lining in the crosshead, would give a reasonable working life before overhaul.

Silver steel could be used as an alternative, or even ground gauge plate. I believe that Whistons stock gauge plate in ½ in. x ¼ in. section, and it would not take long to mill or file this down to 7/16 in. wide.

The recess at the rear end (where the slide bar is bolted to the projecting bracket on the motion plate) could be cut first by a ¼ in. dia. end mill, followed up by a small Woodruffe cutter, to eliminate most of the radiused corners left by the end mill, the slide bar being held in the vice bolted to the vertical-slide.

The crossheads should be interesting items to make. I think they are best cut from the solid, bright mild steel of 1¼ in. x ¾ in. section being required. There must be two or three ways of tackling the machining. I would prefer to start by cutting the slot for the slide bar. To make sure that this is cut both to the correct width and depth, make up the bronze lining strip and measure the thickness of this carefully, adding it to the thickness of the slide bar, which will give the required depth of slot.



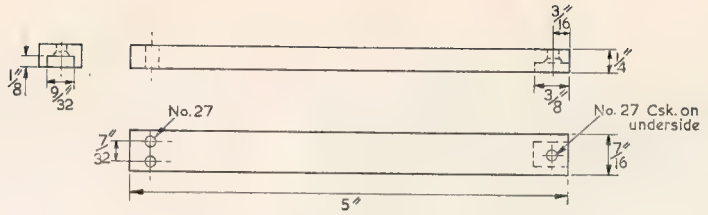
VALVE CROSSHEAD: 2 off b.m.s. case-hd.(2XFS)

Although the slot can be end milled, on small lathes end mills don't usually leave a very nice finish and where possible a side-and-face cutter may be preferred. The crosshead blank could be clamped in a machine vice bolted direct to the cross-slide and packed up to the required height so that the cutter can cut the slot in one pass as to depth, the saddle only being moved to left and right as required, according to the width of the side-and-face cutter being used. If the lowest back-gear speed is used and the job flooded with cutting oil, a good finish should be obtained.

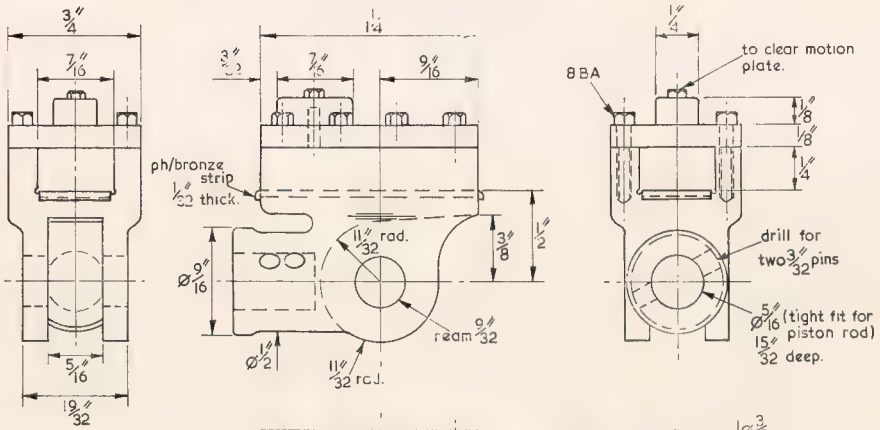
To drill and ream the hole for the gudgeon pin, the crosshead blank can be put on the surface plate (or its equivalent) upside down, and a deep line scribed with the surface gauge. After centring, the blank can be held in the 4-jaw and the centre-pop set to run true, so that the tailstock chuck can be used for drilling and reaming.

The next operation would be to mill out the recess for the connecting rod. This is where a cross-slide milling spindle would come in very useful, but the operation could also be done using a 5/16 in. dia. end mill in the chuck or collet, the blank being held once again in the machine vice bolted to the vertical-slide. The method is to start cutting with the blank "up-ended", the front end that will later form the piston rod "neck" standing up vertically. So that the vice can get a good grip, a scrap piece of 7/16 in. x ¼ in. material should be inserted in the slide bar slot.

The end mill can now be brought in until 11/32



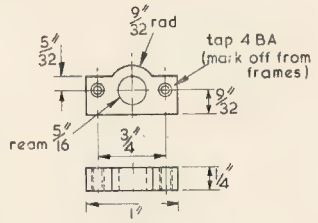
SLIDE BARS: 2 off b.m.s

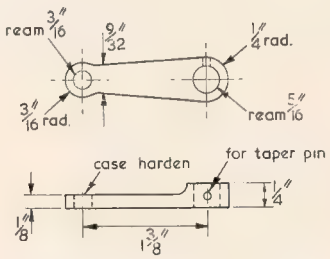


CROSSHEAD: 2 off b.ms (X 2)

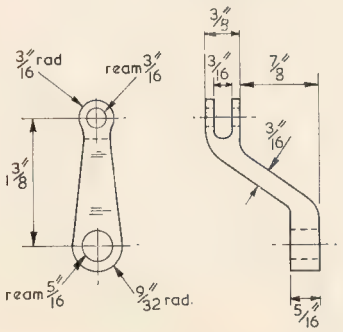
GUDGEON PIN: 2 off carbon case-hd. steel

WEIGHSHAFT BEARINGS



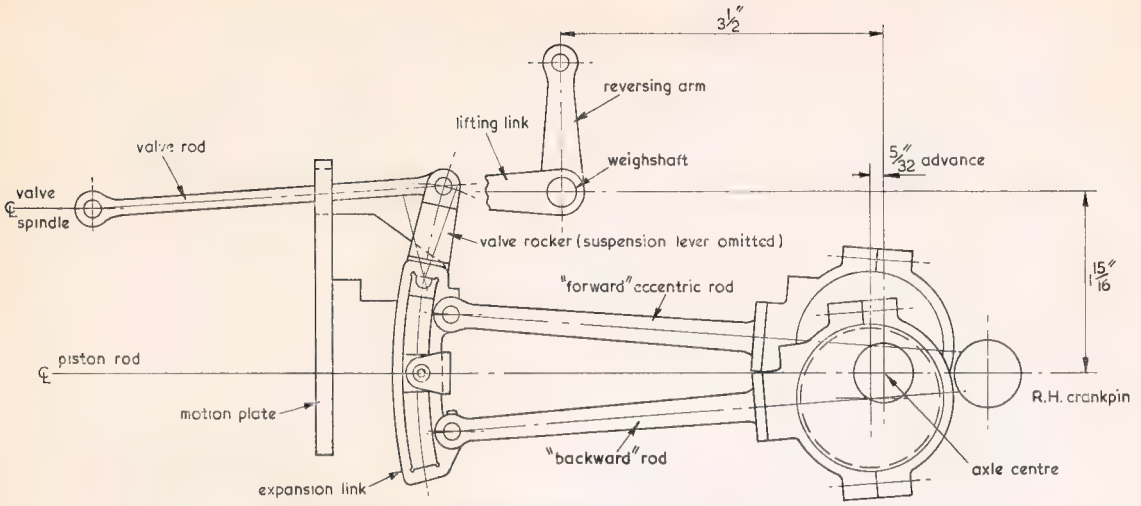


LIFTING LINK 2 off b.m.s.

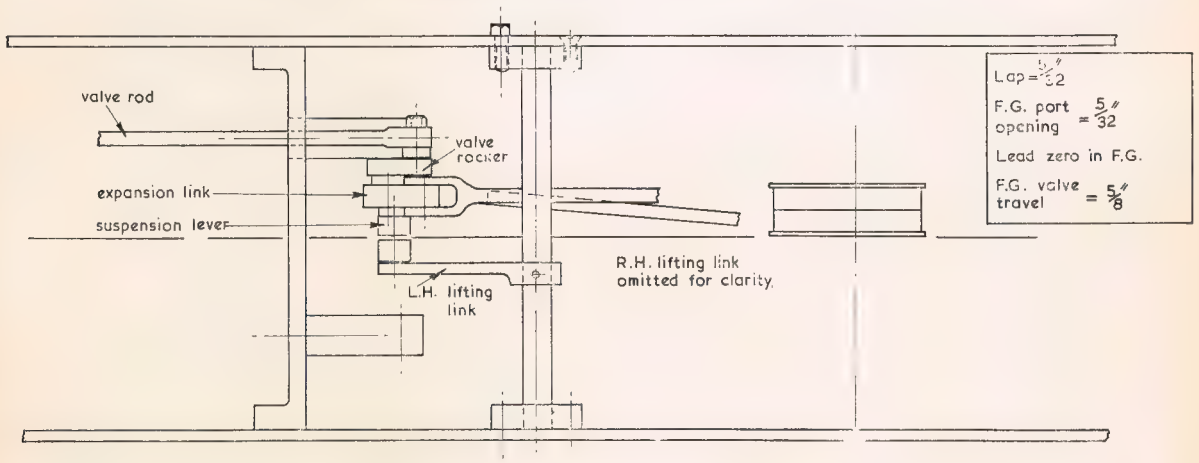


REVERSING ARM: 1 off b.m.s.

WEIGHSHAFT ground m.s. 1 off



GENERAL ARRANGEMENT OF VALVE GEAR R.H. drawn



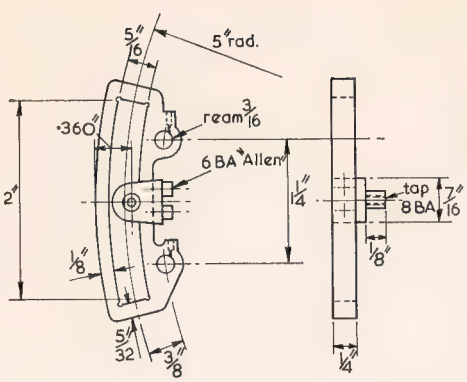
PLAN OF VALVE GEAR

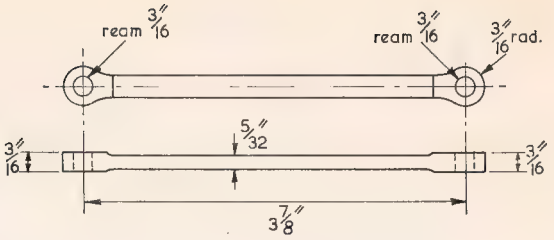
in. past the centre of the gudgeon pin hole, the top of the end mill being in line with the centre of the hole, not higher at this stage or too much metal will be cut out.

The vice is now slackened and the blank rotated in short stages through about 90 deg., i.e. until the crosshead is completely upside down. This method does not of course leave a smooth internal radius (which would only be possible if some form of radius turning tool was used) but if a dummy conn. rod little end, plus a temporary 9/32 in. dia. pin is made up, it will soon be apparent if sufficient metal has been cut away to clear the actual connecting rod. Owners of the smaller lathes may be well advised to use a ¼ in. end mill to start off with, finishing with the 5/16 in.

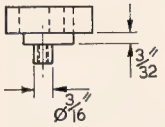
To shape the neck of the crosshead and to drill or bore it for the piston rod is mainly a matter of very careful setting up, using the 4-jaw again. This is where a D.T.I. is almost indispensable. Owing to the "lead" on a normal commercial reamer, this is not a suitable tool here, and I always prefer to drill to a few thou. undersize and finish with a small boring tool. Only very fine cuts must be taken, the piston rod being to hand and tried in place after every cut. The ideal fit is one where it is just possible to twist the piston rod right home by hand pressure alone.

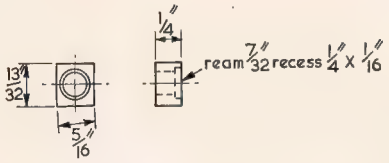
It will soon be realised that it is not possible, with any normal turning tool, to turn the neck of the crosshead more than 1/16 in. or so past the slide bar bearing part, or in this particular case, a matter of 5/16 in., but if the remainder is left rectangular, it will not matter at all and will hardly be visible once in position between the frames. This will mean that one of the two 3/32 in. pins



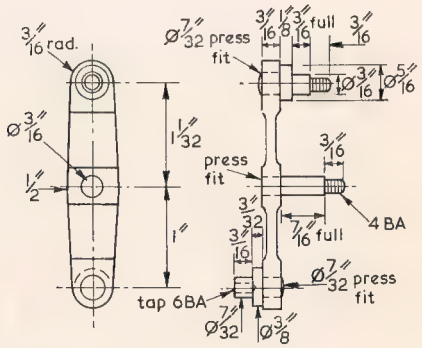


VALVE ROD: 2 off b.m.s. case-harden

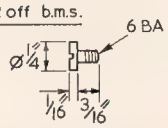




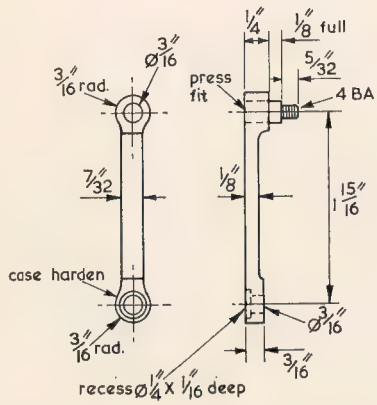
EXPANSION LINK & DIE BLOCK: gauge plate hardened



VALVE ROCKER: 2 off b.m.s.



DIE-BLOCK SCREW
(harden head)



SUSPENSION LEVER 2 off b.m.s.

will be put through the circular part (the neck proper) and the other through the rectangular part, but again this won't present any difficulty.

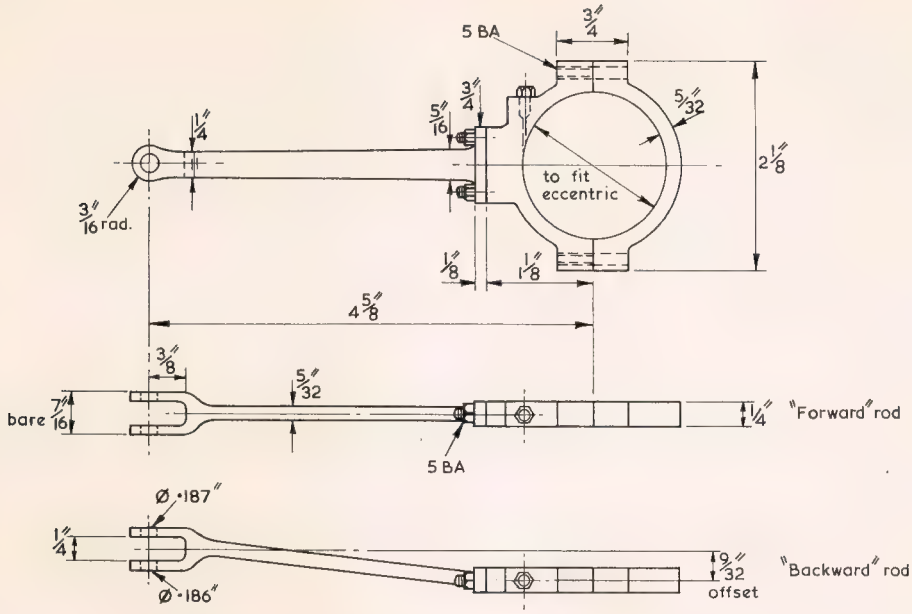
The two final operations on the crosshead involve reducing the width of the lower part of the body of the crosshead—to 19/32 in.—and shaping around the little end recess, this last being done by filing.

The top plate of the crosshead is cut from $\frac{1}{8}$ in. b.m.s. and is held down by eight 8 BA hexagon head screws—the small-headed variety would look nice. A rectangular oil box may be fitted to the top plate, which would give a realistic finish to the job.

For the gudgeon pin, we really need something a bit more "sophisticated" than ordinary silver-steel. A good carbon case-hardening steel is the ideal, such as EN32, EN32M or EN202. I have even heard of the shank of a high-speed drill being used for a gudgeon pin. I should think this would wear well, though I can't claim to have had any experience of such a material used in this way!

The Valve Gear

The valve gear is of the Stephenson-Churchward type, that is as far as the expansion link and lifting arrangements are concerned, but the rocker gear is of course quite different. IMPORTANT NOTE: In the general arrangement I have shown the main crankpin to the rear of the eccentrics (i.e. at the



ECCENTRIC RODS & STRAPS rods b.m.s. straps ph/bronze or gm.

back dead centre) for the sake of clarity, but when valve setting, builders must not forget that due to the rocker reversing the movement of the valve spindle by 180 deg. the crank will actually be at front dead centre when the eccentrics are in the position shown.

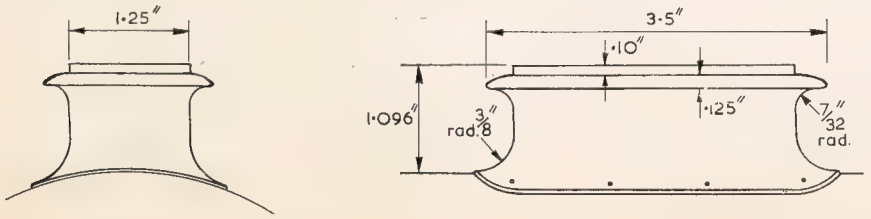
Some model locomotive designers seem to be a bit shy at stating what their valve travel, lap and lead, etc. are supposed to be. However, there is really no need for such secrecy! The full gear valve travel of *Super-Claud* should be $\frac{5}{8}$ in., the lap is 5/32 in. and the port opening in full gear 5/32 in. The valves should be set with no lead in full gear, and a line-for-line setting on the exhaust side.

The expansion link is generally considered the "hardest" part to make of most valve gears, but if some kind of milling attachment is available, there is nothing really difficult about cutting the curved slot. Suitable attachments have been described many times in these notes, but if any newcomer to the hobby is in doubt, I will be only too pleased to send him full particulars on request. One thing I would say, that if gauge plate is to be used (and this material is well worth while here) it definitely pays to rough out the curved slot by drilling and filing first, so that the end mill has only a little metal to remove. A moderate speed and plenty of cutting oil once again will ensure a good finish.

Although the die-blocks could also be milled on the attachment, as they are only 13/32 in. long, it is hardly worth the trouble of setting up for them and they can be hand filed.

The valve rocker is cut from b.m.s. of $\frac{1}{2}$ in. x 3/16 in. section. Note that the two arms are not exactly the same length. This is to allow for any slight slop that may appear between the eccentrics and the valve itself and may well pay dividends when the engine has done a few miles. Builders should make sure that the three pins are really tight in the rocker; it would be rather disastrous if any of them should work loose in service, especially on an inside-cylinder locomotive!

Continued on next page



Corrected drawing of the Double Chimney LMS rebuilt Royal Scot dimensioned for 5 in. gauge.

The remaining valve gear parts should not need much description. I'm sure all builders will realise the need for a simple jig to get all four eccentric rods the same length. The bearings for the weighshaft shown immediately above the reversing arm could be made from flat bronze or gunmetal bar, while the weighshaft itself is nothing more than a plain length of 5/16 in. dia. ground mild steel.

The reversing arm might cause a little trouble, due to its rather extreme offset, necessary to clear the boiler. I think that if a section of b.m.s. say $\frac{5}{8}$ in. x $\frac{3}{8}$ in. is used, and this first reduced to 9/16 in. x $\frac{3}{8}$ in., the bend might be put in the plain bar, before marking out and drilling. The job could then be held in the 4-jaw, for drilling from the tailstock, thus ensuring that the holes at either end are truly parallel to one another. The slot at the reach rod end could then be milled, and the remainder of the job filed to shape.

To be continued

ERRATA

In the frame drawing of Super-Claud *on page 391, April 16th, the dimensions given for the vertical frame stretcher just to the rear of the driving horn block are only correct if an angle is used with the angle to the left of the stretcher. If the $\frac{1}{4}$ in. thick plate stretcher is used as described, the row of holes should be $2\frac{3}{16}$ in. from the axle centre—not $1\frac{13}{16}$ in. as shown.*

In the drawing of the driving axle on page 652, the $4\frac{11}{16}$ in. dimension (the "back-to-back") should of course be to the wheel seats, not to the oil hole centre as drawn.

A VERTICAL COLUMNAR ENGINE

"Tubal Cain" describes how to build a model of the "Williamson" engine

Part II *From page 743*

Continuing with the machining of the column, face one end of the chunk, and then reverse in the chuck and knock this face hard back onto the chuck body, with the chuck jaws tight. Turn the projecting end to $2\frac{1}{4}$ in. dia., face the end, and form a spigot to fit the hole you have machined in the column base. Finally, drill a hole, say 7/16 in. dia., to pass a drawbar. Find a piece of rod (anything over 5/16 in. will do) and screw both ends, long enough to go through the mandrel and project a couple of inches into the column.

Make a cross-piece to go through the apertures in the casting—see page 743 for the arrangement—but it mustn't project any more than is necessary. Use this to pull the casting hard back onto the spigot—don't forget to use washers, a brass one where it beds on the tail of the mandrel. Note that it is vital that the stock on which the spigot is turned be hard up against the face of the chuck before you turn the spigot, or the draw-bar will upset all. You can now face the end of the casting, leaving a few thou. on and, if needed, do any roughing needed on the outside diameter. Fit a plug if you wish. Now machine the 2 in. dia. spigot on the top. I know this says "2 in. less 1 thou." and you haven't a 2 in. mike; never mind—it only means that the spigot should be a snug fit in its mating hole. Finally, finish the face to length—work as close as you can, but the cylinder clearance spaces are sufficient to allow you "half a sixty-fourth" if that is the best you can do.

Next to finish the shapely curves. You can make a form tool if you wish, but I did it by hand turning. If you have no handrest, set up a piece of $\frac{3}{8}$ in. or $\frac{1}{2}$ in. square bar in the toolpost—the bigger the better so long as the tool can come down to centre-height. It must be as close to the job as you can get — hence the reason for the short cross-bar through the apertures of the column. If you have no hand tools, use a medium or large hand scraper. Sharpen it well, and hone the cutting edge to a high polish. It must be sharp and be kept sharp. Run in slow back-gear till you get the feel of it, and then speed up so long as you get no chatter. Start with the top end—fit a plug and use the tailstock—and bring the cutting edge up to the work with *very*

slight pressure and the scraper flat on the top of the rest. It may only just cut, or only just not cut. If it wants to cut hard, the rest is too low. Adjust it. Then, to put on cut, apply a trifle more pressure and very slightly lift the handle—only a trifle. Keep your other hand holding the cutting edge down on the rest—hard. The ideal position of the rest is when the tool just cuts when it is flat on top of the rest, more when the handle is raised a little, and stops if it is lowered. As soon as you have the feel of it, work round the curve, from large diameter to small, till it looks right, well balanced on either side of the major diameter. There is a little radius where the bulb meets the parallel part—this can be formed afterwards with the sliderest.

Now for the other end. Here the chuck may get in the way, and you will have to use an angle tool. If you haven't one, make it from a flat file—one that is about $\frac{1}{8}$ in. thick. Grind off all the teeth, and then a bit more, and then form the end to a 45 deg. angle. On no account allow the end of the tool to colour — use your water pot frequently in the process.

Polish out the grinding marks with a smooth stone, and then heat the shank till the business end turns pale straw. (Files usually are not tempered.) Fit a really good handle and make sure it has a good grip of the tang—right on. Having sharpened and honed the cutting edge, proceed as before, using the angle tool for the side you can't get at with the flat one. Note that the angle tool will have to be tilted rather than raise the handle, and this means you must have a really good hold of it, or it will take charge.

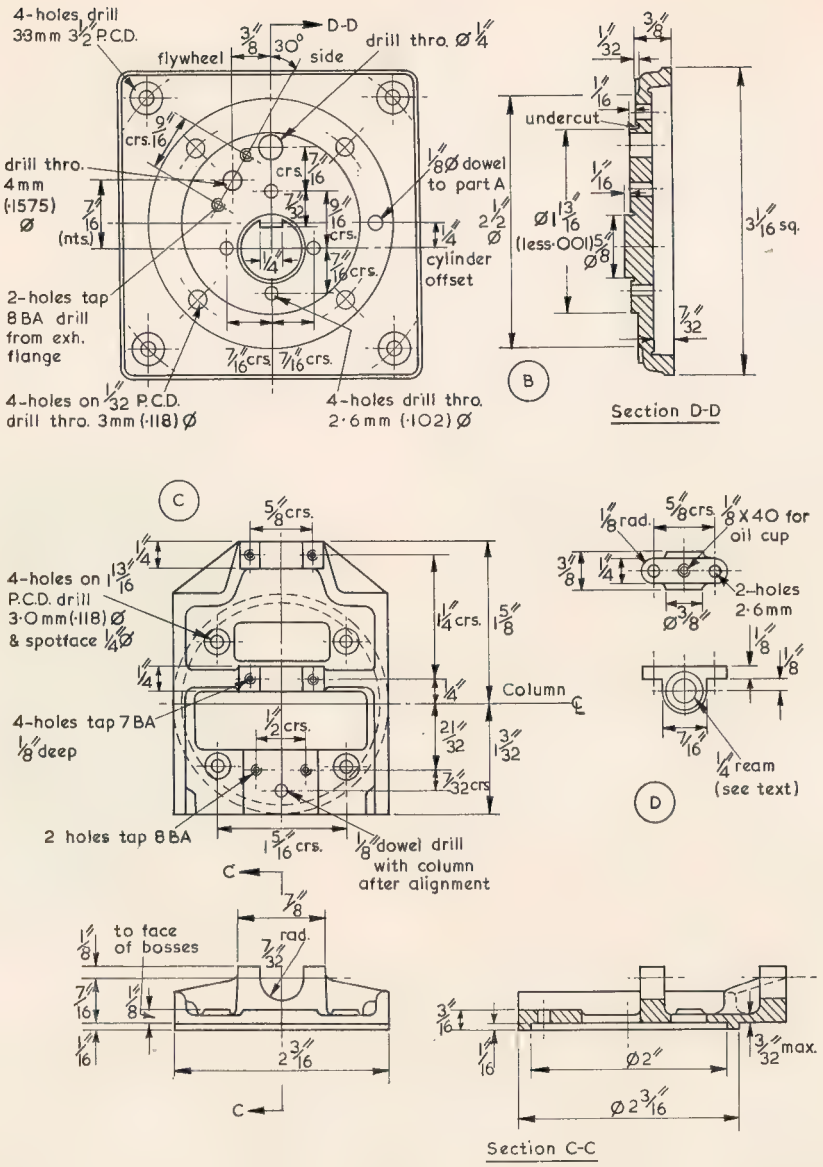
Once you have the profiles to shape, proceed with the finishing. This is done with the same tools, but with even finer honing of the edges, much lighter pressure, and at higher speed. Finish with fine emery paper, then to finer and finer grades till you are satisfied. If you are going to paint the bulbs, of course, no need to polish. (The originals would be painted probably for normal customers, but polished for specials!) During this process, slip a tube from the centre of a toilet roll over the column, to keep your fingers out of the holes. Whilst in the lathe, finish off the surrounds to these holes—it is easier done when you can rotate the work than in the vice. Finally, before taking from the machine, check all the dimensions.

The studholes in the top and bottom of the casting are marked out from the mating parts—but take care when you break through, both in drilling and tapping. Use paraffin as a lubricant. This job comes later, but I will mention it now. You must take great care that the base, column, and entablature are correctly aligned — you don't want the apertures in the column to look askew. My practice is always to spot through only one hole, drill and tap that, offer all up with studs in place, and if it needs correcting, draw the hole with a file. Then spot through with this stud (and a clamp) tightened to hold the parts together. The final job at this stage is to mark out for and file out the clearances for the crank and eccentric and drill the two little holes in the side which give access to the steam chest bolts. After which, re-prime. I painted my first one so that you could see what it looks like—see Fig. 3. Note, by the way, that I hadn't trimmed up the surrounds as I suggested you do, and you can see what happened! (This is the "Mark I" column, which was bored out at the top; yours will be different, having an external spigot instead.)

Fig. 3. The machined and painted column.

Base, Part B

Set up in the 4-jaw to machine the underside—you may have to grip by the corners to ensure that it beds down properly. Machine the bottom edge, till the machined face is 11/32 in. from the unmachined part of the top of the casting. Note—when setting up make sure that the lip on the bottom edge is running reasonably true, or it will look odd. Then face the internal machined pad to $2\frac{1}{2}$ in. dia. and 7/32 in. below the previously machined edges. Reverse in the chuck and tap hard back to the chuck—use packing if need be—and adjust the position till the four sides are true to centre. Machine the $2\frac{1}{2}$ in. dia. face and, if your tool will clear the chuck jaws, the bolt pads as well. Use a sharp knifetool in forming the spigot itself, and undercut the root a trifle. Now take a cut right across, over the cylinder spigot (at present running offset) to give a clean face for marking out. Set one side of the casting level with a spirit level and scribe a line across at centre-height. Set this line vertical


4-holes drill 33mm 3½ P.C.D.
flywheel side
D-D
drill thro. Ø ¼
drill thro. 4mm (·1575) Ø
(nts.)
2-holes tap 8 BA drill from exh. flange
4-holes on 1/32 P.C.D. drill thro. 3mm (·118) Ø
4-holes drill thro. 2·6mm (·102) Ø
⅛Ø dowel to part A
cylinder offset
undercut
3 1/16 sq.
Section D-D
4-holes on 1 13/16 P.C.D. drill 3·0mm (·118) Ø & spotface ¼Ø
4-holes tap 7 BA ⅛ deep
2 holes tap 8 BA
⅛ dowel drill with column after alignment
Column
⅛ rad.
⅝ crs.
⅛ X 40 for oil cup
2-holes 2·6mm
¼ ream (see text)
to face of bosses
rad.
Section C-C

with a square, and again scribe across. Working from these lines you can now mark out for the other holes (except those on the $1\frac{3}{4}$ in. dia. face) and for the centre of the cylinder spigot. Fig. 4 shows work in progress.

Now reset the casting true to the cylinder centre, making sure that the casting is hard back on the chuck face or jaws. The cylinder spigot must be machined parallel to the other faces. Machine and face the cylinder spigot. (If you prefer to machine such spigots to fit the cylinder, the job can be laid on one side and done later, so long as you remember to bed the casting down in the chuck at the time.) Mark out the holes on this face, but leave the two 8 BA ones for the exhaust flange. These are marked out from the pipe itself in due course. Drill all holes. (Leave those for the dowels, of course, till you erect; don't forget them, as I may well do in the subsequent description of the assembly!) Re-prime the unmachined parts and set aside.

Entablature, Part C

The design called for an unmachined area on the underside of this casting, but for production reasons (to keep the cost of your castings down!) the machining allowance will be left on all over, so you must cut the surplus away when you face this side. You are going to need to Araldite the

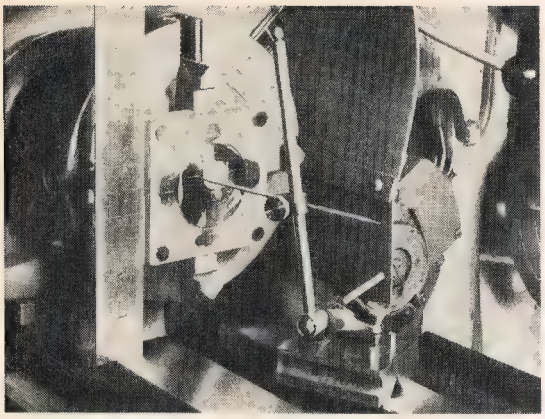


Fig. 4: Marking out the engine base. The rule is held upright with a magnet behind.

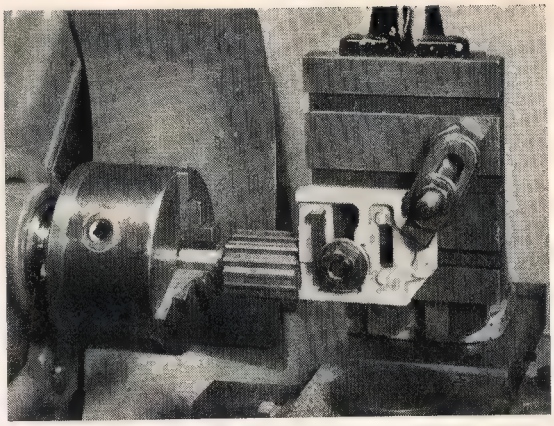


Fig. 5: Machining the front face of the entablature.

sideplates to this casting, so take care to avoid oil getting on the job if you can.

Set up in the 4-jaw, base outwards. One jaw may have to be reversed for this. Set true to the sides of the casting, and also make sure that the casting lies flat relative to the chuck body. This is a fiddly job, as packing is little help, but take some care over it. Machine right across till the thickness of the casting to the unmachined part of the top face is 5/32 in., and then take off another 1/16 in. from the outside in till there is a pad 2 3/16 in. dia. which will be 5/32 in. thick. You now have to form a socket for the top of the column in this pad. Rough out this cavity undersize, going in about 60 thou., using your feedscrew index to measure with. Now grind your boring tool to a point to leave a sharp internal corner, and finish both the bore and the face of the recess. Take care, as this face and bore are essential to correct alignment. The column should be a snug but not tight fit. Using the same procedure as for the base, set the job square and mark out the centre-lines and then the sides and front—1 3/32 in. from the centre-line in each case; take care that the sides are parallel, and square to the front edge.

Remove from the chuck, and either file or mill the sides to dimension. Fig. 5 shows how I did it, though you are unlikely to have a cutter like that —70 years old, probably! Mill the front edge or face first and this can then be a reference to which the others can be set. The fourth side—that where the main bearing housing is—shouldn't need any metal off, but if it does it can be cut round off the edge of this part so that it looks "cast". Whilst in the vertical-slide you can mark out if you like, using the vertical and cross-slide indexes to get your dimensions, but it's just as easy to do it on a surface plate in this case.

Reset the vertical-slide to face the headstock and set up the casting either in a machine vice or with clamps. (You can't use a bolt in the middle.) Set true to the centre-line with a square from the lathe bed. Machine off the tops of the main bearing housings to correct dimension. If you have a small enough cutter you can also get down to machine the bolt-pads and then do the face on which the governor bracket sits. If you like you can file the lot, and use a chisel on the recessed parts—the firm who made the original may have had a planer, but it's pretty certain they had no milling machine at that date. There is *no reason at all* why you shouldn't use a file wherever I say "mill" (or set the thing up in the 4-jaw and face it) and a chisel where a file won't go.

Once the bearing tops are faced you can mark out from the centre-line for the width of the bearings chops. These can be milled to width, but only $\frac{1}{8}$ in. deep; the semi-circular part will have to be filed. Make the width so that the brass extrusion just won't go in, and file the latter to suit—having taken the casting from the machine first, of course. Check that the odd-shaped holes in the base which pass the crank and the eccentric are to dimension, and file them out if not. Mark out for and drill the four No. 32 holes, spotfacing them if you didn't mill them. From these you can spot through to the column (bearing in mind my previous remarks on this process; look at the drawing carefully to see which is front and which back in relation to the cylinder spigot on the base!) and drill and tap that; one more little job done.

Now for the main bearings, part D. Saw these off roughly to length and file the ends square and flat, a little oversize. Mark out for and drill the fixing holes, using a square across the brass extrusion to get them in line. Drill these No. 37, and spot through onto the tops of the main bearing housings in the entablature. Mark each bearing to its correct chop so that they go right way round every time. Drill and tap 7 BA and then fit both

blank bearings with temporary screws—steel ones, screwed up tight. Set up the vertical-slide parallel to the lathe bed and attach the casting with clamps and set true to the centre-line. Adjust the vertical and cross-slides till the bearing centre aligns with the lathe centre—that is, with the vertical-slide face ½ in. behind the lathe centre, and the centre-line of the casting at centre height. Fit a small Slocumbe in the 3-jaw and lightly touch the end of the bearing brass; examine the pop-mark for true position and adjust the slides if need be. Then centre properly and drill say 3/16 in. through both bearings. Use a straight flute drill if you have one, otherwise reduce the cutting rake on a twist drill.

To be continued

STIRLING ENGINE

from page 799

burn. Before long the entire hot cap will glow red (if the light is subdued, the red will be quite bright) and the engine will start instantly with the first flip of the flywheel. With such a hot burner water cooling is essential for all but very short demonstration runs.

Now that my burner is right, my engine starts up and instantly sails up to about 2800 r.p.m., then slows back to a steady 2500-2600 r.p.m. It is probably going a bit faster, since my tachometer adds a slight load.

As the photographs show, my burner is attached to the engine by bent strips of .020 in. sheet stainless. This works fairly well, but I recommend a more rigid method of attachment, which still avoids a big heat leak. I leave this to your imagination.

So there you have it; a simple but modern Stirling engine that really performs. I hope readers who decide to build this engine will freely modify the design, and keep me informed of problems (with which I'll gladly try to help) and progress (which I'll incorporate in my next design!).

CLUB NEWS

News from Norwich

The Norwich Society's public running Sundays in June were very successful. On the 6th, six members ran engines, Norman Crews with his *Simplex,* Douglas Hastoe with a *Maisie,* Grahame Hewitt drove his 5 in. gauge *Butch,* Brian Reading a 3½ in. gauge G.W.R. "County" and Barry Steel a 5 in. gauge 2-6-0. Making a welcome return was Len Taylor with his 3½ in. gauge L.N.E.R. "A.3". On the 20th, the *Simplexes* of Dick Allen and Norman Crews were in steam, together with Albert Peacock's 3½ in. gauge *Royal Scot* and Barry Steel's 2-6-0.

Secretary: A. W. E. Hoskins, 5 Hellesdon Road, Norwich.

Northampton A.G.M.

At the A.G.M. of the Northampton Society of Model Engineers, all the retiring officers were re-elected with the exception of Mr. K. Markie who was succeeded by Mr. K. Harriss as Vice-Chairman. The Society meets at the track in Delapre Park every Tuesday evening and at Kingsthorpe Community Centre during the winter months.

Secretary: D. Hillier, 43 Broadmead Avenue, Northampton.

Mid-Cheshire Society

The Mid-Cheshire Society of Model Engineers was formed in Hartford, Northwich, by five members in June 1974. By spring 1975 a 100 ft. portable track for ground level operation had been built and two 3½ in. gauge locomotives were in running order. Late in 1975 negotiations were started with the local Parish Council for a site for a permanent track, but this project had to be abandoned. Fresh negotiations were then started with the Cheshire County Council for a site at the Moss Farm Sports Ground, Winnington, Northwich, and after discussions lasting six months, the go-ahead was finally given. Initially, the new track will be a straight run of some 530 ft. with steaming bays, turntables and passing loops. The track will be at ground level and will be built with ¾ in. x ⅜ in. mild steel welded to cross-ties supported on timber sleepers, these being bedded into a concrete foundation 12 in. wide x 4 in. deep.

Last winter, membership rose to 12, with four locomotives operational; also in the Society two traction engines are being built, a 1½ in. scale Allchin and a 3 in. scale Burrell.

Secretary: David Robinson, 15 Beach Road, Hartford, Northwich, Ches.

News from Coalville

Since March this year, an ambitious project has been in progress by the North-West Leicestershire M.E. & E.S. which has headquarters at the Miners' Welfare Centre, Coalville. This is to build a raised 3½ in. and 5 in. gauge permanent track on land adjacent to the Centre. The new track has been designed by members Don Sorsby and Brian Neale, assisted by Ken Wright —all from Derby. Working parties are on Wednesday evenings and Sunday mornings, and "site manager" Don Tebbatt will be pleased to show visiting model engineers how things are going.

Secretary: A. E. Bath, 6 Creswell Drive, Ravenstone, Leicester.

Furness A.G.M.

At the A.G.M. of the Furness Model Railway Club, the following officers were elected: Chairman, R. Watson; Treasurer. M. Thomas; Secretary, H. Morrall, 91 Holker Street, Barrow-in-Furness, Cumbria.

"Simplex" Rally

With the great popularity of the 5 in. gauge locomotive design "Simplex", the Stafford & District Model Engineering Society propose to hold a Rally for "Simplex" owners. The date proposed is Sunday, 5 September, and suitable prizes would be awarded.

"Simplex" owners are asked to get in touch with the Secretary, Mr. D. A. Amey, Windward, Boat Lane, Weston, Near Stafford.

The Editor welcomes letters for these columns. He will give a Book Voucher for £3.00 for the letter which, in his opinion, is the most interesting published each month. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

Valve Gears

SIR,—Mr. Lewitt's interesting but rather academic poser regarding the curve applied to Stephenson's link motion expansion links must have exercised the minds of many locomotive engineers over the years. Probably the salient point is that the increase in lead towards mid gear, whilst manifesting itself at the dieblock and hence also at the valve, really has nothing to do with the expansion link curve, so why try to cure it here?

The normally used formula $\frac{c}{l} \times t \cos \Theta$ can in fact be reduced to $\frac{cx}{l}$, where c is half the eccentric rod pin spacing, l is the effective eccentric length (inclusive of the offset pin dimension for a launch link), and x is the 90 deg. or quadrature component of the eccentric. Since none of these factors involve the expansion link it may not seem particularly pertinent to attempt a cure for variable lead in the link slot. Further, it will soon prove undesirable to deviate from the normal curve for reasons of inequality of the other events. Even so, the curve of the slot is not that of the eccentric rod length in optimum circumstances, because to achieve *equal* leads at each end of a double acting cylinder, the length of the eccentric rods will require adjustment to slightly longer than the link slot radius. In full-size practice the adjustments were made at valve setting by calling upon the services of the blacksmith, but in our scales it is probably wiser to find the actual length by simple graphical test.

One dodge used in full-size practice was to advance the eccentric *pair*, so that the forward eccentric showed a greater advance angle than the backward one. The effect was to shift the characteristic curve such that it was almost at 90 deg. to the crank in forward gear, thus providing a negligible variation in lead, but at the cost of greater variation in backward gear. With the locomotive links usually used the most disturbing part of the backward gear lead would in fact disappear at around 70 per cent cut-off—more than adequate for an express engine.

However, is the cure sought by Mr. Lewitt really necessary? An average increased lead in 5 in. gauge would probably be around 0.27 in., so for a gear set at lead = nil in full gear, and running at an average cut-off of some 25-30 per cent. then the lead would amount to something like 0.020 in., which I could decide is too much. while the next man can equally deem it too little. The whole point of choosing open rods was to apply the greater lead at speeds of greater need. I find it rather hard to accept the same principle under the vastly different circumstances prevailing in 5 in. gauge, and this may be Mr. Lewitt's problem.

To my mind there is a distinct possibility that Mr. Lewitt, at least in his letter, places too much importance on wanting to keep the starting point of inlet constant, whereas I submit that preservation of equality of cut-offs will have considerably more influence on cylinder performance. Far too many little engines have differences of 10 per cent or more in this respect, making for neither economy nor performance. As Mr. Lewitt obviously has an interest in valve gears I assume that he knows how to achieve both equality of leads *and* of cut-offs; those not conversant with the matter can do no better than consult H. S. Gowan's excellent article in the SMEE Journal for December 1975.

Yet another perennial raised by Mr. Lewitt is the choice between curved and straight slides for the Hackworth/Joy family of gears. The problem here is identical to that in the case of an expansion link, as I am sure Mr. Lewitt appreciates. We normally use a perpendicular setting of the Walschaerts' expansion link, i.e., such that raising and lowering the radius rod has no effect on the valve, to set the eccentric rod and return crank. Yet this is the *only* position in which a curved link is correct, because the curve itself introduces an inequality of cut-off which does not disappear until the mid gear position is achieved. However, as with the characteristic curve in Stephenson's gear the effect is distinctly non-linear, and cut-offs shorter than. say, 50 per cent show the error down to around 0.005 in. in a well-designed 5 in. gauge gear. Attempts to get rid of this, possibly by offsetting the expansion link trunnion centre. are almost certainly governed by the Law of Diminishing Returns, though the effort is well worthwhile to those who. like Mr. Lewitt, are fascinated by valve gears and their idiosyncrasies.

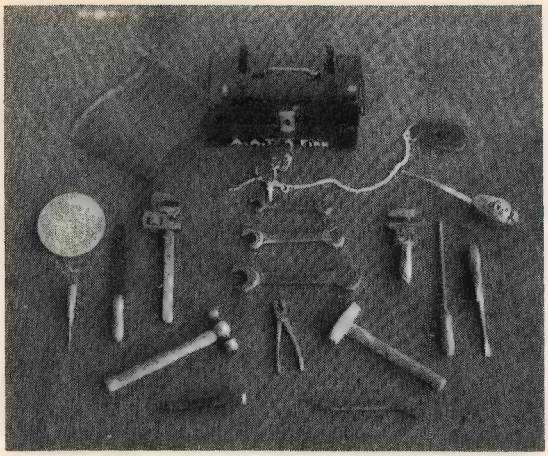
Cadishead, Manchester. D. L. Ashton

Making Miniature Tools

SIR,—The article on "Accessories for Model Traction Engines" which appeared in issues 3535, and, particularly, 3536 in which some of the tools were detailed, prompts me to send you the enclosed photograph of a set of tools made recently. They were all cut, machined or filed from $\frac{1}{8}$ in. thick flat spring steel (except those obviously made from round stock which was silver steel) and hardened and tempered to make them as near lifelike as possible.

It all started with the need for a 5 BA set spanner for some of the nuts on my $3\frac{1}{2}$ in. gauge *Maisie* which has been under construction for an incredible number of years.

When making the spanner I thought it might just as well be a scale copy of the real thing though 5 BA in 1/16 scale, blown up to full size, would probably be a bit larger than most of the nuts on the original. However, in due course a spanner, 5 BA one end and 6 BA the other, materialised. I thought it looked rather nice! Then the whimsical thought came "Could I make a scale shifting spanner?" In keeping with the period of *Maisie* as a G.N.R. around the turn of the century it was considered a Clyburne or Bahco would be an anachronism and I tried to recall the construction of a good old monkey wrench, square-jawed and with a wooden handle which nestled in my old Dad's toolbox when I was a youngster. As the smallest tap and die I possess is 1/16 BSW this determined the size of the adjusting screw and the rest had to fall into place. When completed it looked fairly authentic and measured up to about 1/12 scale; a little big for a



3½ in. gauge loco and probably more suited to 5 in.—but that is how it happened.

At this stage I was well and truly hooked on making a set of engine-driver's tools, all to the same scale, and began to wonder just what would have been in the box. Ideas flowed thick and fast and manufacture began. The side-cutting pliers were the next to be tackled as they presented more of a challenge than most of the others. When completed they worked and actually cut wire (copper!). Then the hammers, the ball pein mainly on the lathe with the side flats and octagonal waists being filed; the 4 lb. was turned and tapered each end and then the square flats machined. Shafts were made from lollipop sticks sandpapered to shape though they do have circular centre marks with the dimple in the middle as if turned on a wood lathe.

After the hammers a chisel was a natural and milled octagonal from silver steel and then filed to shape. It was ground sharp after tempering. The pinchbar was also silver steel as were the shanks of the large and small screwdrivers with their lollipop stick handles, suitably shaped, and tiny metal ferrules fitted to avoid splitting.

The files may be cheating a bit. The flat was ground from an old magneto file while the round file was obviously a scrap of Abrafile tapered as much as the teeth would allow without looking silly. The oilcan, from scraps of coffee tin, will feed oil in tiny drops and the thumb button is spring loaded for realism. The Stillson wrench operates as in full size with springs controlling the opening of the jaws. Two other double ended spanners, 7/8 BA and 9/10 BA. complete the set. All the tools are functional and would be more so if only one had scale-sized fingers to operate them. A handful of cotton waste would lend realism to the collection but I have not yet found anything that looks "scale".

Naturally, all these tools had to be accommodated in a box so the rest of the coffee tin was shaped to suit with edges wired and a piano hinge along the back and hasp and staple in front. My daughter said "Of course, you are going to make a padlock for it" and I said "Of course!" Why do I say such things? Throughout her life she has had great faith in my ability to "do" things, dating from the time when, not two years old, she tearfully presented me with the remains of a Marie biscuit she had dropped and said "Daddy, fix bistik". I couldn't let her down, so many sessions later and thoroughly cross-eyed after hours with a watchmaker's loupe stuck in one eye, I had a padlock just 5/16 in. across which clicks shut to lock and requires its own—not any old, mark you—key to open it. This key has to pass a couple of internal protuberances which simulate wards and is so small that it was thought desirable to attach it to a ring with a couple of other keys to make a bunch with a view to avoiding loss. A model Yale key serves as the driver's front door key while a mortice lock key secures his drinks cupboard. Even this bunch is so small that a need was evident for some sort of tether so a short length of silver chain with snap hook, the only purchased portion of the set, was attached with a leather tab to fasten over a trouser button.

The flags are not truly part of an engine-driver's equipment but were added to give a splash of colour to an otherwise drab exhibit. The coin, to give some idea of scale, is 5/16 in. across, the same diameter as the old British 1s. piece.

And now you know why my *Maisie* never seems to get any nearer to being finished!

Salisbury, Rhodesia. A. A. T. Finn

Steel Axleboxes

SIR,—I would suggest that if steel axleboxes are to be used with white metal liners, the procedure should be such that full adhesion of the lining to the body is attained. The method suggested by Mr. Gladden relies solely on the grip of the white metal in the scores of the bore; if the steel is heated to blue first there can be no surface adhesion at all and in the event of failure this will be catastrophic, with pieces of the lining coming quite adrift.

The orthodox procedure is not difficult. Bore out the hole in the steel say 3/32 in. to ⅛ in. oversize for 5 in. gauge using a finishing cut of about 8 thou. per rev. with a tool having a slightly rounded point. Thoroughly degrease and then tin the bore. Pure tin is preferable, but a high-tin soft solder will do at a pinch. Whilst the box is hot and the tin still molten, sprinkle on some powdered resin and wipe out all the surplus tinning (I use a bristle brush for this). If the molten white metal is ready then it can be poured in straight away, but if not then the box must be reheated but only till the tinning shows bright; I would apply a little more powdered resin if there has been any length of time between the two operations.

The "pan head" pool of metal suggested by Mr. Gladden is probably quite an adequate header for an axle of say ¾ in. dia., but a preferable method is to leave a shoulder about ⅛ in. tall round the bore which can be machined off when the white metal itself is bored. I usually feed such bearings with shavings of white metal, being the nearest approach to full-sized practice, where the bearing has a tall header, "fed" with rods of metal during the cooling process.

A bearing lined in this fashion will hold up even if excess loading causes the white metal to craze, as each segment of the lining is, in effect, soldered to the body. The thickness of the metal is by no means critical but there is an advantage in having 1/32 in. or more (in a ¾ in. axle, as for *Super-Claud*, that is) in that if a severe "hot box" causes the metal to melt, the fact is immediately obvious. I think Martin Evans' comments on "tinned linings" referred to bores in which only a few thou. of tinning was used?

I confess that I haven't used this method on little locomotives—the local geography is not favourable to rail traction! — but I have lined bearings equally heavily loaded down to ½ in. dia. and seldom experienced a failure.

Kendal. "Tubal Cain"

Milling Attachment

SIR,—Perhaps these few hints may be of assistance to those of your readers who, like myself, have bought an Amolco Milling Attachment and married it to the Myford ML7 lathe bed.

While this milling accessory is a splendid device, it does impose severe limitations on tailstock work for the lathe proper. One job which frequently crops up is the drilling from the tailstock of holes in work held in the headstock chucks, and in order to avoid complete removal of the milling attachment from the Myford I have devised and made the following fitments. First of all I made a Drummond type toolpost (but with an open rather than a closed tool slot), and secondly a No. 2 Morse taper female adaptor to hold the ½ in. Jacobs chuck. This taper adaptor is fitted with a rectangular section gripping bar running along one side, parallel with the axis of the taper and bolted up snugly with three 0 BA socket screws. By means of the rectangular gripping bar which is held in the Drummond toolpost slot, the female taper and hence the ½ in. Jacobs chuck can be readily held in position. Height and alignment adjustment are no trouble at all with the Drummond toolpost, and when using this set-up for drilling objects held in the headstock chucks or faceplates there is even the additional advantages of automatic drill feed using the leadscrew, which could not be used with simple tailstock drilling.

There is also another precaution which might be used by Myford operators, this time when using the cross-slide as a slot cutting or planing facility. As can be readily realised, the force involved in thrusting a slotting tool across the face of work held in the headstock is considerable and the somewhat scaring feature of this operation is that this transverse planing or slotting thrust is, in the ML7, borne into the cross-slide from its feeding handle by two 4 BA screws only. This might not be too bad were it not for the fact that the body of the cross-slide is a casting tapped to accept the two 4 BA screws, and this type of casting, while excellent from the viewpoint of straightforward dimensional stability, is certainly not the world's strongest material for resisting the pull-out of 4 BA threads. What I have therefore done is to drill out these 4 BA threads and re-tap with No. 2 BA which takes the load better; likewise the threads in the top-slide.

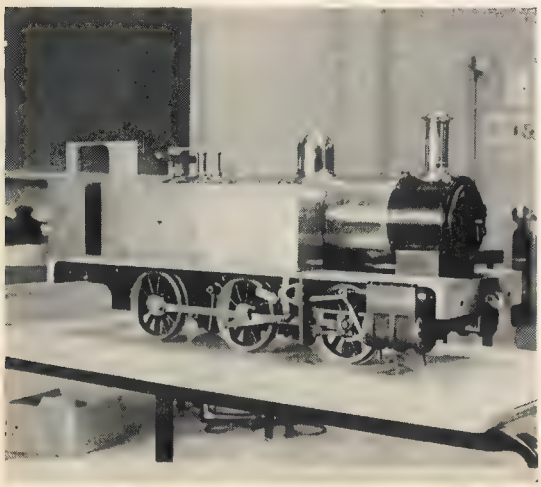
I shall be pleased to see comments from yourself and readers.

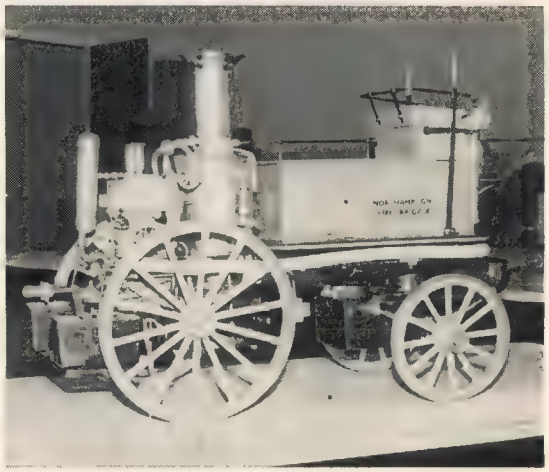
Waltham Abbey, Essex. J. C. Cannell

AT THE NORTHAMPTON EXHIBITION

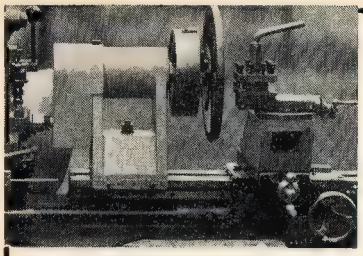
Pictures by D. E. Lawrence

A 3½" gauge S.R. "Schools" 4-4-0 by Len Gillett
Below: Unfinished "Simplex" by P. Spiking





A Shand Mason fire engine by S. Pratt
Below: Model of training ship "Danmark" by P. Clowes



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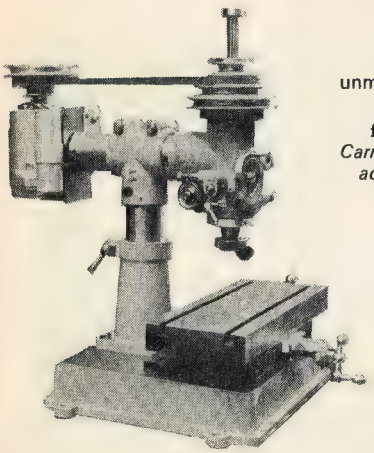

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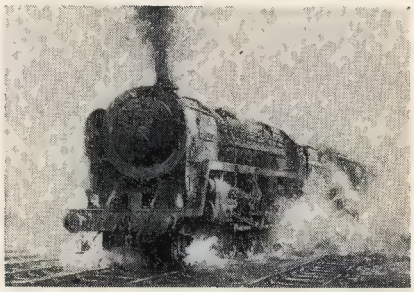

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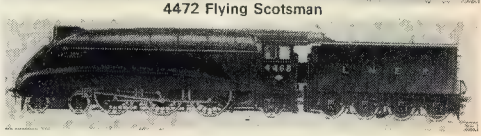

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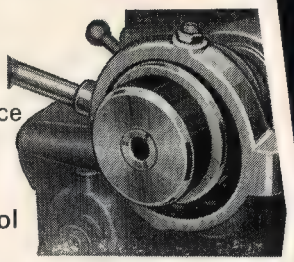

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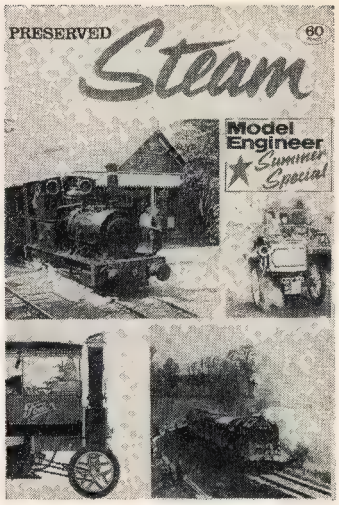

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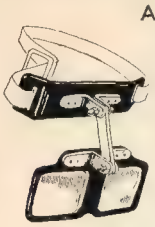

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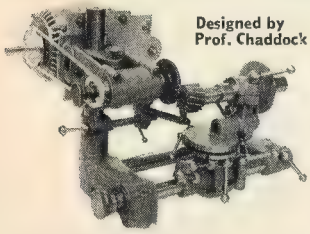

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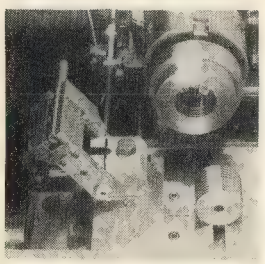

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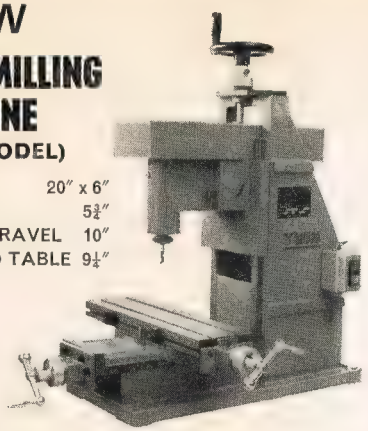

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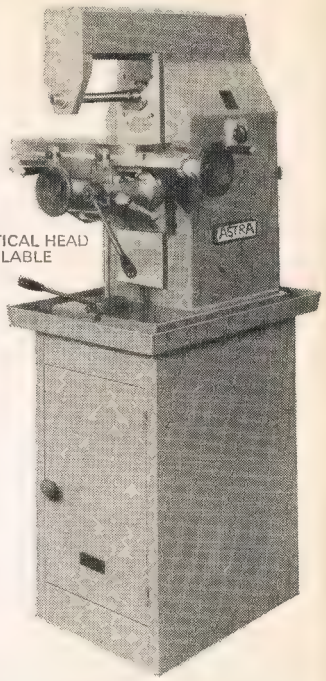

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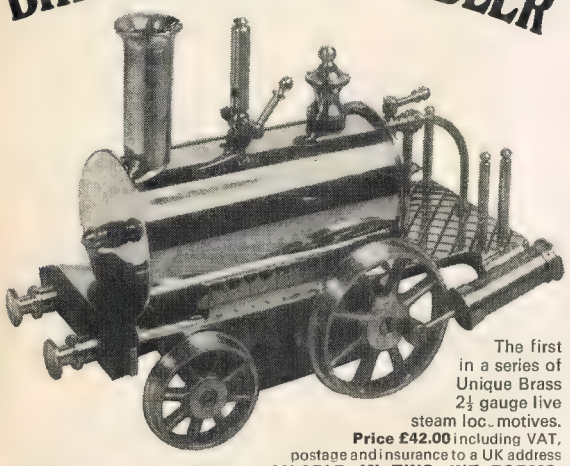

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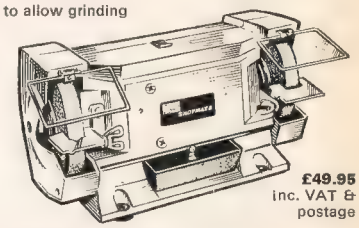

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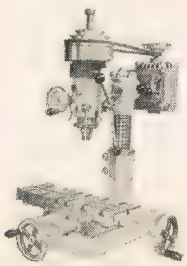

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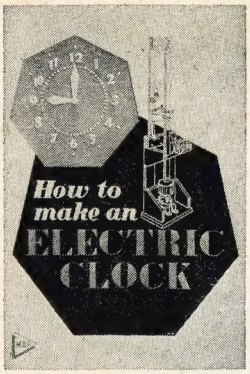

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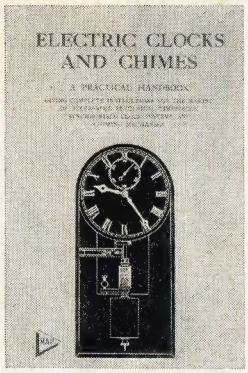

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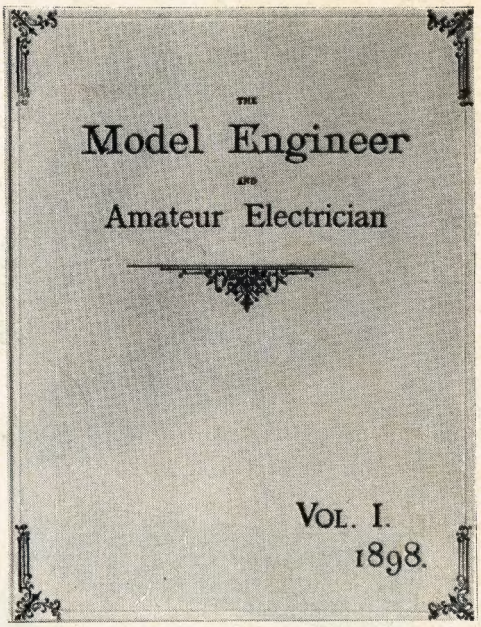

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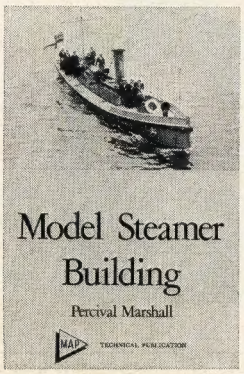

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